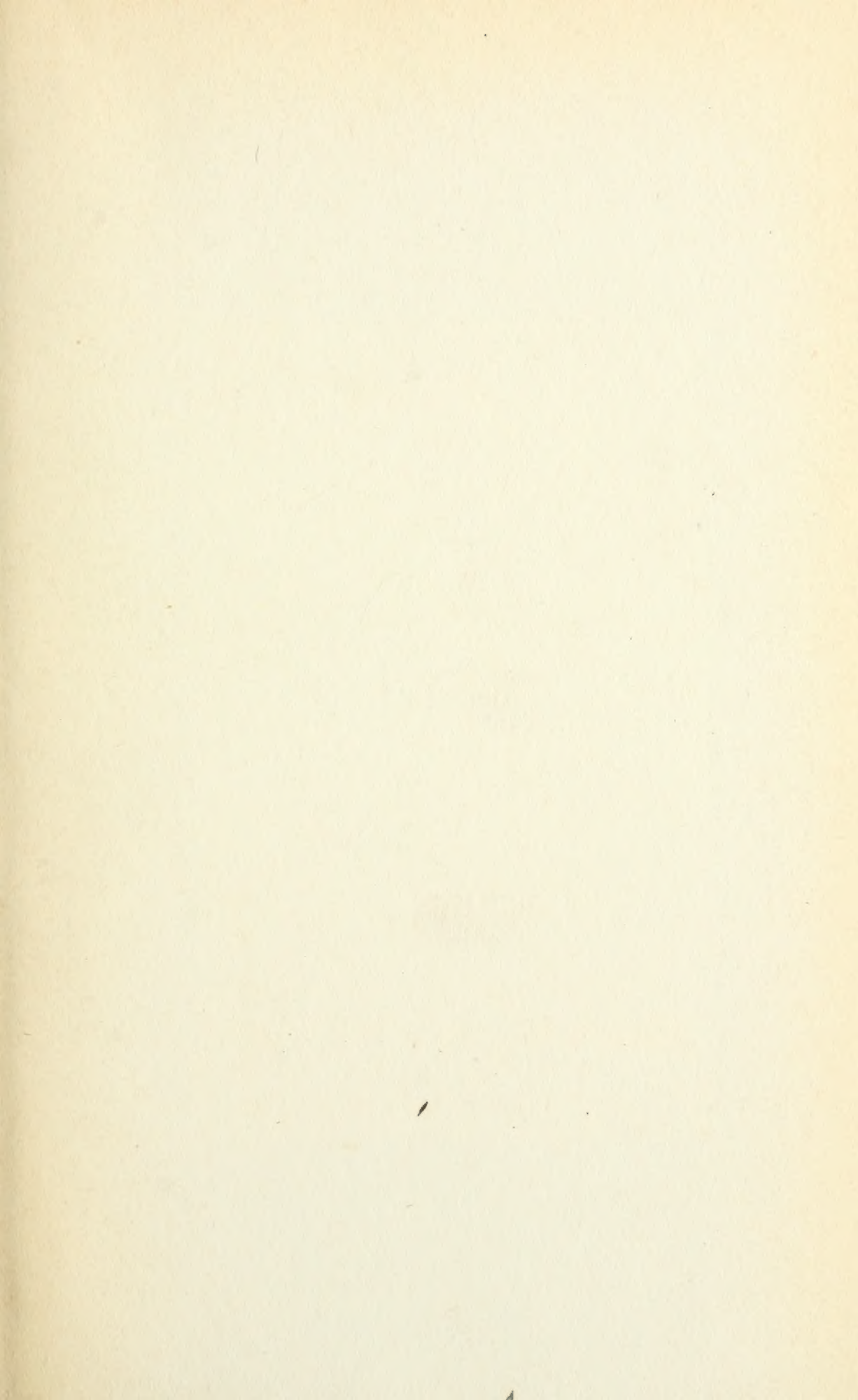




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PROGRESSIVE MEDICINE

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES
AND IMPROVEMENTS

IN THE

MEDICAL AND SURGICAL SCIENCES

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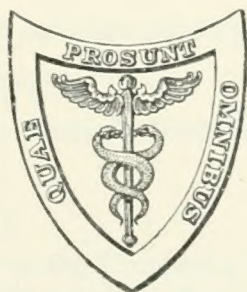
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SURGERY OF THE HEAD, NECK AND BREAST—SURGERY OF THE THORAX, EXCLUDING
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RHEUMATISM, CROUPOUS PNEUMONIA AND INFLUENZA—DISEASES
OF CHILDREN—RHINOLOGY, LARYNGOLOGY AND OTOTOLOGY



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PROGRESSIVE MEDICINE.

MARCH, 1918.

SURGERY OF THE HEAD, NECK AND BREAST.

By CHARLES H. FRAZIER, M.D.

GUNSHOT WOUNDS OF THE HEAD.

BECAUSE of the war there has been a decided reduction in current medical literature. This is true to a certain extent in this country, but in a larger measure, of course, in European countries. Scarcely any journals from Germany or Austria are available, and there has been a curtailment in the size and number of those from England and France. The articles of European source that have to do with the surgery of the head, deal almost altogether with gunshot wounds or collateral subjects, and, as military surgery is now uppermost in the minds of the profession, I shall begin this year's contribution to PROGRESSIVE MEDICINE with a general review of this subject.

The interest of the American surgeon has been aroused in the subject by the fact that in the organization of the medical forces of the army the Surgeon-General has recognized a Head Section. Through the activity of this section, two noteworthy things have been accomplished. Three schools in neurological surgery have been inaugurated, in Chicago, New York and Philadelphia, where for a period of ten weeks the Medical Reserve Officers have received an intensive course of instruction in subjects dealing with gunshot wounds of the head, spine, and peripheral nerves. Secondly, a book of reference on War Surgery of the Nervous System has been issued from the Surgeon-General's office. This book of 360 pages includes abstracts of practically all the important or available articles on the subject that have been published during the war, together with articles from standard works germane to the subject. It is a most valuable book of reference and should be available for every medical officer who may be called upon to deal with this particular field of surgery. As indicative of the recognition on the part of the Surgeon-General of the advisability of making special provision for the treatment of head and spine injuries, plans have been considered for the establishment of a special head hospital on the other side.

Little has been added to our previous conception of the pathology of those processes that are concerned in intracranial trauma, such as concussion, contusion and laceration of the brain, or of the mechanics of gunshot fractures of the skull. As to the physiology of the brain, by which I mean the localization of special functions, I think the more important contributors deal with the spinal cord rather than with the brain. But Lister and Holmes have reported their results of the study of a large number of cases with occipital lobe injury, from which they determined the relative position of the foci that subserve vision of separate portions of the visual fields. The following are their conclusions:

1. The upper half of each retina is represented in the dorsal, and the lower in the ventral, part of each visual area.

2. The center for macular or central vision lies in the posterior extremities of the visual areas, probably on the margins and the lateral surfaces of the occipital poles.

3. That portion of each upper quadrant of the retina in the immediate neighborhood of, and including the adjacent part of, the fovea centralis is represented in the upper and posterior part of the visual area in the hemisphere of the same side, and *vice versa*.

4. The center for vision subserved by the periphery of the retinae is probably situated in the anterior end of the visual area, and the serial concentric zones of the retina from the macula to the periphery are probably represented in this order from behind forward in the visual area.

These observers have made further contributions on the nature and seat of motor apraxia, that is, the inability to perform purposeful actions despite the preservation of movement, and in the disturbance of the faculty of localizing by vision objects in the external world. No doubt at a later period, when the rush and strain of military activities is over and greater opportunity is afforded for a thorough digest of the vast amount of material that is accumulating, we will see a large number of articles dealing more particularly with cerebral localization. Certain it is that the European surgeon and neurologist will have had opportunities far in excess of the American for clinical research along these lines, and if the profession of this country expects to make a record at all comparable, special hospitals should be established for foreign service and their staffs should be the ablest thinkers in this particular field.

I shall review at this time the more practical aspects of gunshot wounds; that is, those concerned with the treatment. There has been an arbitrary classification into three groups: The so-called tangential wound, where the bullet strikes the skull a glancing blow, grooving the outer table without puncturing it, and shattering sometimes the inner table; the penetrating, or through-and-through, wound, where the bullet passes through the brain and finds an exit; and lastly, the wound where the missile or projectile, bullet, shell or shrapnel fragment, lodges in the brain substance. Each of these present different problems.

The subject which above all others has excited the greatest controversy has been the time and place of operation. Shall the operation be performed in the evacuation or base hospital? Possibly because the

evacuation hospital has developed into an institution of larger proportion and of greater importance, the French surgeon, as compared with the English surgeon, favors the earlier opportunity.

At one of the meetings¹ of the Société de Chirurgie, which continue apparently uninterrupted, held in conjunction with the Société de Neurologie of Paris, there was a symposium on the treatment of war injuries of the head.

The following is a translation of the resolution passed by the Société de Chirurgie in Paris as it appeared in the *War Surgery of the Nervous System*.

All head injuries should be carried from the place where they fell to the place where they can be operated upon as rapidly as compatible with the military necessities of the moment.

All head injuries should be explored immediately upon arrival at the designated hospital, regardless: Of the hour of arrival, of the date and hour of the wound, of the statements on the diagnosis tag, of the clean appearance of the dressing, or of the patient's state of fatigue.

Head injuries should, whenever possible, be transported directly from the battlefield to the evacuation hospital, because—

(a) Once operated upon they should not be subjected to further transportation until they are convalescent.

(b) Because field ambulances and field hospitals are within range of artillery fire and the noise and concussion are very detrimental to such cases.

If primarily evacuated to a field ambulance or field hospital, the wound should be prepared surgically (shaving, scrubbing, trimming, and dressing) before further evacuation to the rear.

Radiography is of inestimable value, but a temporary break-down of the apparatus should not deter the surgeon from immediate exploration.

French surgeons strongly advocate tincture of iodine and ether in the surgical preparation of the case.

Head injuries should reach the operative table from two to six hours after being injured.

General Treatment of Cranial Injuries. 1. Whenever available, the skiagraph should be used in order to determine the type of fracture and the presence or absence of missiles.

2. Thorough preparation of the surrounding area, carefully protecting the wound from further contamination.

3. Removal of all devitalized and lacerated soft tissues.

4. Removal of all small, or sharp-pointed, fragments of bone, and preservation of large fragments.

5. If the dura is intact and no focal symptoms have developed, leave it alone and reclose the wound after replacing all large bone fragments.

6. If the dura is torn and the skiagram reveals the presence of spicules of bone or of one or more missiles, gentle exploration of the lacerated brain tract with the gloved finger and removal of the foreign bodies cannot further traumatize the tissues.

¹ Bull. et mém. Soc. de chir. de Paris, 1916, xlii, 1475.

7. The giant magnet is often useful in the removal of metal fragments (except copper). Unless the exact angle of penetration of the missile is recognized and the magnet is so manipulated as to draw the missile out along this same angle, considerable additional trauma to brain tissue may ensue. The weight and bulk of the magnet also make it difficult to keep in the zone of the advance.

8. Severe hemorrhage or persistent oozing from one of the main branches of the middle meningeal hemorrhage will require double ligating with fine catgut. Persistent oozing from the pia or arachnoid is readily controlled by applying small pieces of muscle tissue.

9. Dural defects should be closed by pieces of fascia or dental rubber.

10. Intradural drainage should not be resorted to.

11. Wherever possible the wound should be sutured, leaving a small drain extending to the meninges.

12. The dressings should only be changed when they are saturated or the secretions have dried up, making the dressing uncomfortable.

Indications for Trephining. 1. No obvious signs of depressed fracture but: (a) Entrance and exit wounds are far distant from one another. (b) Patient unconscious at the time he received his injury. (c) Persistent headaches or giddiness. (d) Fracture of outer table without depression of same.

2. Depressed fractures without injury to the dura.

3. Fractures with injury to the dura.

4. Fractures with injury to the dura and presence of a foreign body.

SHOULD BONY FRAGMENTS BE REPLACED? Small, sharp, irregular fragments should never be replaced, as they tend to shift about and traumatize the dura. Large, depressed, fairly even fragments should have their sharp edges trimmed off and may then be sterilized by boiling (or immersion in ether) before being replaced.

If a trephine has not been used, punch a circular opening through the most dependent portion of the fragment for drainage. The skin flap will keep the bone in its proper position. The advantages of replacing such pieces of bone are:

1. Prevention of hernia cerebri.

2. Scaffolding over which bony or fibrous cells proliferate.

SHOULD THE INTACT DURA BE INCISED? (a) Never if normal colored and pulsating normally.

(b) Invariably, if the surface of the dura is decidedly cloudy or blackened, tense, and non-pulsating, or it presents a circumscribed loss of elasticity (unequal tension). One will invariably find a hematoma or a contused brain area, or both, in such cases.

SHOULD A TORN DURAL OPENING BE ENLARGED? Yes, invariably. Enlarge the cranial opening if necessary in order to expose normal dura. Make a semilunar incision through dura beyond the traumatized area; remove all lacerated dura. After completing the operation cover the dural defect by means of (a) fascia lata (best); (b) dental rubber.

Remember that a piece of fascia as large as the palm of the hand will contract down to one-half or even one-third of its normal size. It should either be tucked in under the bone or lightly anchored to the dura with very fine interrupted catgut sutures.

Dental rubber makes an excellent non-irritating protective membrane; it has also been used to cover peritoneal defects and contused arterial or venous walls (Matas).

WHAT ARE THE BEST METHODS FOR CONTROLLING INTRACRANIAL HEMORRHAGE? (a) Pieces of muscle (autogenous) applied directly to the bleeding surface without making undue pressure.

(b) Coagulen Kocher-Fonio 5 per cent. solution in sterile water, boiled not to exceed five minutes and freshly prepared.

HAVING ENLARGED THE DURAL WOUND, WHAT FURTHER STEPS ARE NECESSARY? (a) Removal of blood clots.

(b) Trimming of lacerated brain tissue.

(c) Removal of bone spiculæ, pieces of cloth, dirt, etc.

(d) Search for, and removal of, metallic foreign bodies which have been previously localized by the *x*-rays.

IMMEDIATE REMOVAL OF FOREIGN BODIES IS JUSTIFIED BECAUSE:

(a) Track through brain tissue is already present.

(b) No further injury to brain tissue need be made.

(c) If wound is large, sepsis is already present.

(d) Abscess has not formed.

SECONDARY (LATE) REMOVAL OF A FOREIGN BODY PRESENTS THE FOLLOWING DISADVANTAGES: (a) Exploring through scar tissue.

(b) Additional laceration of brain tissue.

(c) Often have to operate in an infected area (abscess, etc.), with danger of dissemination of the infection.

(d) The presence of a metallic body within the cranial cavity is a constant menace to the patient.

Technic of Removal. (a) Use all proper means of localizing the foreign body by means of the *x*-rays. Of special importance is an exact estimation of the depth of the object from the surface.

(b) Gently explore the sinus leading to the object with the index finger of left hand; locate the object with tip of finger.

(c) Pass a small spoon (gall-stone scoop) alongside finger and engage foreign body in the scoop.

(d) Withdraw finger and scoop simultaneously, with the foreign body between the two. This minimizes traumatism of brain tissue.

(e) Should the metallic body be embedded in bone, gently push aside brain tissue by means of two or three groove directors, thus enlarging the sinus. Introduce straight or curved forceps and endeavor to loosen the object. If successful, withdraw forceps and proceed as in (c) and (d). If not successful, a small chisel and hammer may be necessary in order to free the object.

SHOULD INTRACEREBRAL DRAINAGE BE USED? No. It is dangerous and always irritating. Extradural wicks may sometimes be used. Drainage from skin to trephine opening is commonly used and maintained until all danger of sepsis is past. Drains should only be changed on definite clinical indications. Extradural wicks should be renewed every second or third day.

LATE COMPLICATIONS IN HEAD INJURIES USUALLY CAUSED BY: (a) Latest activation of an encysted abscess.

(b) Exuberant bony callus causing pressure symptoms.

(c) Meningeal adhesions or scar tissue within brain substance, producing circulatory disturbances.

The manifestations are innumerable, and the treatment pertains entirely to the base hospitals. The French Army surgeons recommend that a trephined soldier should never be sent back to the firing line.

At the Congress of Italian Surgeons, Bologna, March, 1917, Alessandri² advised early exploration in tangential wounds in which the missile does not lodge in the tissues, in more or less superficial lesions, when the missile has traversed the cranial cavity entering at one side and finding its exit on the other, and in penetrating wounds in which the bullet lodges deeply, with removal of the latter whenever this is possible. The radiograph is generally acknowledged an indispensable adjunct in exploration and in the removal of foreign bodies.

Because it represents a line of Italian thought up to August of this year, the conclusions to which Maccabrumi³ has arrived, are interesting. We note that he recommends early operation, the removal of deep foreign bodies, only partial closure of the wound, and tamponage or suture for hemorrhage from the sinuses. The conclusions follow:

1. Systematic intervention in all penetrating wounds is necessary; only a very few cases make an exception to this rule.
2. The operations should be performed immediately. The sooner the intervention, the better the probability of good results.
3. It is advisable to examine the nervous system in every case, avoiding tiring the patient.
4. The radiological examination should in almost all cases precede the operation to obtain as exact a location as possible of the intracerebral projectile.
5. The osseous defect should be reduced to a minimum; it should be a few millimeters larger than the meningeal lesion.
6. All bony fragments projected into the brain should be extracted; the epidural space should also be carefully explored.
7. Deep-lying projectiles should be early extracted whenever their removal is possible without producing greater damage.
8. In cases of vast wounds, with tearing of brain substance, drainage with gauze is extremely useful.
9. In all cases in which the wound is probably infected, *i. e.*, in the great majority of cases, the suture of the skin of the scalp should not be completely carried out.
10. The suture of the dura mater should be reduced to a minimum.
11. In lesions of the large sinuses, when hemorrhage cannot be stopped with simply tamponing, it is best to use a suture, limiting the use of forcipressure to cases of extreme gravity and urgency.
12. Bandaging should be renewed as rarely as possible.
13. The rules of the most scrupulous asepsis should be followed in bandaging as well as in the operation.

² Gazz. d. osp., 1917, xxxviii, 296; Il Policlinico, 1917, sez. frat., xxiv, 797.

³ Pensiero Medico Milano, 1917.

14. The small cerebral hernias are reduced with compressive treatment; in large hernia all attempts at reduction should be omitted.

15. If the existence of a cerebral abscess has been diagnosed, it should at once be opened and drained.

16. The nursing of the patients should be most careful.

17. The patients should not be removed until a complete surgical cure.

18. The greater part of the deaths was due to the lesion itself; less frequently to meningo-encephalitis, suppurating cerebral hernia, and cerebral abscess.

Cases of opening of a ventricle, of hydorrhea, ependymitis, and consecutive encephalitis were almost always fatal.

Of 44 cases operated upon, 16 died. All cases of death belong to penetrating wounds with lesion of the dura mater and protrusion of cerebral substance. No case of penetrating wound of the head without infection of the meninges died.

In contrast to this almost general inclination of French and Italian surgeons to early operation, Sargent and Holmes⁴ call attention to two factors that interfere with the apparent advantage of immediate operation—they are the ease with which the subarachnoid space can be infected and the tendency to hernia. Delayed operation permits the formation of adhesions between the edges of the dural wound and the pia-arachnoid, and thus, by walling off the subarachnoid space, reduces the danger of infection. Furthermore, during the early stage there is a traumatic edema of the brain which of itself increases intracranial tension; if this is further increased by manipulation or by meningeal infection, hernia is more likely to result. While not overlooking the risk of infective encephalitis and its possible extension to the ventricle as the result of allowing fragments of bone to remain in the wound, they believe experience shows the greater risk, nevertheless, to be attendant upon early interference.

In fact, immediate operative interference in the British lines seems to be tabooed. Near the front there is not the time for a careful neurological and x-ray examination, and what is of very great importance, early evacuation of these cases after operation often spells disaster. Contrary to expectations, immediate surgical intervention for the relief of cerebral symptoms, either focal or general, is seldom called for. The only attention that the wound may require at the front is directed toward the prevention of infection.

According to Bowlby and Wallace,⁵ it was observed at the base hospital that those who, on arrival, had not been operated upon, did better than those who were operated upon at the front. Many of the septic complications seen at the base were attributed to improper management of the case at the front. The two principal reasons for the unsatisfactory condition of patients arriving at the base, therefore, were too early evacuation after operation at the front, and the lack of either skill or judgment in the surgical management of the case. To meet the exigencies of military emergency, it was decided that in time of pressure

⁴ British Journal of Surgery, 1916, ii, 474.

⁵ Ibid., June 2, 1917.

the wound should be cleaned and the patient sent to the base as soon as possible. If the patient was operated upon, he is retained at the Casualty Clearing Station for a week or ten days. A further development in the solution of the problem by the British was the establishment of special hospitals for head cases. The advantages of these seemed obvious: There was in the first place not the necessity for hurried evacuation, as from the Casualty Clearing Station, and at the special hospital the staff and equipment were especially chosen for dealing with neurological cases. If at the Clearing Station the pulse is slow, the patient is sent to the base; if the pulse is rapid, the patient is put to bed and not sent to the base until he improves.

Having determined the first question, that is, the time and place for operation, the next question naturally was as to the limitations and general scope of the operation. This question may be said to include, among others, the toilet and care of the wound, the removal of foreign bodies, the closure of the wound with or without drainage. For practical purposes the cases, according to Sargent, may be divided into two groups, according to whether the dura has, or has not, been penetrated. The technic for the non-penetrating cases is simple and the mortality low, providing the surgeon respects the integrity of the dura. It comprises the excision of the margins of the wound, the removal, when necessary, of bone fragments and the partial, or complete, closure of the wound. For the penetrating wound, Sargent says the following plan is now generally accepted: The wound is cleansed and dressed as soon as possible, and the patient transported to the base hospital for further observation. In those cases in which the longitudinal sinus has been injured, where the bullet has passed directly through the head, or the missile lies deeply imbedded in the brain substance, operation is usually contra-indicated.

The instances of severe intracranial hemorrhage not rapidly fatal are few, and even among those there are a certain number that are not likely to be saved by operation. The recognition of an intracranial hemorrhage sufficiently large to warrant operative undertaking for its relief, is usually not difficult, so that there are few indications for the so-called exploratory operation.

At the same time that the best type of operation, as regards the scalp and bony defect was being evolved, many other points were in the process of settlement.

The following is a summary on the management of three cases by Bowlby and Wallace:⁶

1. Excision of the wound was soon decided upon.
2. There was at first considerable discussion as to how far the brain should be explored for bone fragments on the one hand and the projectile on the other. Everyone was agreed that an *x*-ray picture had become a necessity, and the opinion was gradually formed that a limited and intelligent search for bony fragments and other foreign bodies was beneficial, but that attempts to reach a missile which was deeply im-

⁶ British Journal of Surgery, June 2, 1917, p. 719.

bedded in the brain was not justifiable. Results seem to have proved the correctness of this line of treatment, for fragments of shell are reported to have caused little trouble provided their weight was not enough to cause pressure on the surrounding brain during movements of the patient.

3. The fact that many patients with head wounds suffered from septic complications, and the general demand for the drainage of all wounds, led at first to the employment of drainage in most cases of cranial surgery, not only of the scalp but of the brain also. The results of drainage of the brain were not satisfactory, and gradually it was abandoned, at any rate as a primary measure. The introduction of tubes was first omitted, and subsequently systematic attempts were made to cover in the exposed brain, the scalp being brought together over the defect in the bone and dura, either by simple suture, pericranial flaps, or relieving incisions formed by undercutting the scalp. A drain introduced under the scalp is still generally employed. This covering up of the brain seems to have been a decided success, and, although septic complications are still too often met with, they are less frequent than in former times. There has consequently been a great decrease in the number of cases of hernia cerebri.

4. There is still some difference of opinion as to whether small cranial depressions and linear fractures with slight inequality of surface, uncomplicated by symptoms, should be operated on in the first instance.

5. Most surgeons have accepted the recommendation of Sargent and Gordon Holmes that depressed fractures over the longitudinal sinuses should be let alone in the first instance.

6. Most operators are of the opinion that the dura mater should not be opened if found intact. The recognition that true compression of the brain is seldom seen has helped the formation of this opinion.

7. A general anesthetic may, with advantage, be replaced by the local use of novocaine and adrenalin. If this method is adopted, the patient is given either hyoscine and morphine, or omnopon and scopolamine an hour before the operation.

Thus, by careful individual observation, and by the comparison of results, a method of treatment has been evolved which is applicable to all cranial wounds, and capable of modification in individual cases. It may be summarized as follows:

A primary cleansing of the wound. The transmission of the patient as soon as possible to the hospital where he will convalesce. The taking of *x-ray* pictures. The excision of the scalp and bone wound. A limited and careful removal of foreign bodies. The covering of the exposed brain. The closure of the wound, with superficial draining, and a prolonged rest in bed.

Sargent and Holmes⁷ do not advocate the removal of any but superficial foreign bodies, those that come away easily with the removal of bone fragments, or such as later, because of their presence, give rise to symptoms. When, however, removal is indicated, they treat the wound

⁷ Loc. cit.

of extrance along the same lines as though no foreign body were present. After cleansing the scalp and treating it, as well as the wound, with a 2 per cent. solution of iodine, they apply a tourniquet (when the position of the operative field is convenient) of rubber tubing around the head below the inion and immediately above the auricles and the brows and secure it by means of sharp-pointed skin clips. The entire operation is conducted under a rapid stream of hot normal saline. Great stress is laid on this, as it serves not only to wash away much softened brain matter and infective material, but also keeps the operative field clear of blood. After excising the bruised and lacerated margins of the scalp wound, they cut a flap large enough to expose an area of bone well around the limits of the bony opening that is to be made. The opening is then enlarged to expose the dura for at least one-half inch around the dural wound. They find it safest to work from a trephine hole alongside the bony opening rather than through the enlarged existing opening. After picking out any loose fragments of bone, the finger is gently inserted through the dural wound, and any bone fragments encountered in the softened and disintegrated bone tissue are removed with dissecting forceps. The dural opening should not be enlarged as it is usually large enough to permit the necessary manipulations.

Drainage is now established by means of a cylinder of perforated metal (zinc, aluminum or copper). The tube is three-fourths of an inch in diameter and about one and three-fourths inches in length, and is carefully inserted into the tract. The flap is then replaced and sutured, and a small drain of rolled rubber sheeting inserted between two stitches at each lower angle. Any brain matter that may have oozed into the tube is carefully removed by means of a small curette still under the saline stream. The tube is then dried out with gauze and filled with glycerin, and a gauze wick, saturated with glycerin, is placed around the tube, and a large dressing of gauze and wool applied. Glycerin is used because of its hypertonic action, its inhibitory action on the growth of pyogenic cocci and its emulsifying effect in facilitating the escape of disintegrated brain substance. Lumbar puncture is useful in counteracting any increased intracranial pressure and may be repeated as often as it seems indicated. The wound is dressed daily, the contents of the tube being removed and the tube again filled with glycerin. It is allowed to remain in for a week, but should be rotated at each dressing in order to avoid its becoming fixed by granulations or brain matter that may exude through the perforations.

When drainage is indicated, Malan⁸ employs capillary drainage by means of sterilized silk thread, arranged in spirals and put up in glass tubes. The number of threads (as many as 10 to 12) varies according to the size of the wound. The silk threads it is claimed act as a siphon. A similar method is described by Verlet,⁹ who used horse hair.

The Italians have abandoned, to a large extent, drainage, and substituted complete and even hermetic closure of the wound. Even in grave cases this method has been followed by unexpected improvement.

⁸ *Gior. d. r. Accad. di med. di Torino*, 1917, lxxx, 194.

⁹ *Presse méd.*, 1916, xxiv, 59.

While appreciating the disadvantage of closing a possibly infected wound, Bastianelli¹⁰ claims that, with certain limitations, the wider the lesion the greater the necessity for complete closure of the wound for the very purpose of avoiding infection, and more especially hernia with its inherent tendency to infection. The closing of the wound requires scrupulous preparation of the skin with tincture of iodine or iodated benzine, and the wound itself should be treated with Gianetto's and Dakin's solution. With the patient under anesthesia, the margins of the wound, including all contused and lacerated tissue, are excised, and the wound enlarged, usually without a flap. Fragments of bullets and bone splinters are removed, exposing $\frac{1}{2}$ to 1 cm. around the margin of the dural lesion. With the radiograph as a guide, fragments easily accessible, even those beneath the cortex, are removed and hemorrhage controlled by compression or irrigation with hot physiological salt solution for about ten minutes, the application of muscle or fascia lata grafts rarely being required. The entire wound is closed with deep and superficial sutures, and only when hemorrhage is not controlled is drainage employed. Infected wounds should be first sterilized by the Carrel method and then closed.

Collica,¹¹ on the other hand, advocates the open treatment of head wounds on the ground that it takes a long time to eliminate the products of necrosis and is sometimes difficult at first to distinguish necrotic tissue from that which may survive. Of 19 cases thus treated, 4 died. The deaths were due, not to postoperative sepsis, but to preëxisting infection. Bonomo¹² also prefers open treatment, especially when the tract of the bullet is long and bone particles have been disseminated along its tract.

Contrary to the experience of other surgeons, lumbar puncture is not looked upon with favor by the French, except perhaps in the presence of serious intracranial lesions. The only successful cases reported at the Paris meeting were those of Picqué. In one case of meningitis which developed on the fifteenth day after a gunshot wound, with destruction of a large part of the left frontal lobe, lumbar puncture was repeated ten times, accompanied by an injection of electrargol, with complete recovery. A similar result was obtained in a case of meningitis following a tangential wound in the temporomastoid region.

Lerda¹³ considers lumbar puncture an effective postoperative measure, where, after a few days of apparently favorable progress, symptoms of hernia and cerebritis develop. Since observing the beneficial effects of lumbar puncture in a case of hernia, he has entirely abandoned intracerebral drainage, using merely wet dressings and repeating lumbar puncture as often as indicated by increase of the hernia. He repeats it as often as ten to fifteen times on alternate days, sometimes daily, withdrawing as much as 10 to 40 c.c. with excellent results. Lumbar puncture is indicated further when, after operation, there is reason to suspect that the infection may involve the ventricles, or where, sooner or later, symptoms of increased intracranial pressure interfere with

¹⁰ Il Policlinico, sez. prat., 1917, xxiv, 827.

¹² Loc. cit.

¹¹ Il Policlinico, xxiv, 828.

¹³ Gazz. d. osp., 1917, xxxviii, 643.

spontaneous drainage. The results vary according to the freedom of communication of the ventricles with the subarachnoid space. The rapid withdrawal of spinal fluid in large quantities is, of course, contra-indicated in recent injuries where involvement of the ventricles is suspected by the presence of bloody fluid. Repeated withdrawal of small quantities in such cases avoids the danger of continued bleeding. Lumbar puncture is contra-indicated also where there are signs of abscess formation. Sargent and Holmes¹⁴ regard lumbar puncture as one of the most valuable aids in the treatment of gunshot wounds of the head. With proper care, it is useful in reducing intracranial pressure during the stage of cerebral edema and in controlling the tendency to postoperative hernia.

Hosemann's experience¹⁵ is significant because he was stationed at a dressing station and had an opportunity to study his cases carefully. The scalp was shaved about the wound and the latter enlarged if necessary. In 24 out of 79 cases the exploration proved the necessity for operation. There was only 1 case of meningitis, 1 case of abscess and but 9 deaths. Mueller¹⁶ exposed every cranial injury, and to this attributed his low mortality, which in "intradural" wounds was 2.63 per cent. and in "brain" wounds 39.19 per cent. These figures are based on 132 operations, of which 60.5 per cent. were operated upon in the first week and 29 per cent. in the second week. The fatal cases might be divided into two groups: Those of a fulminating character, where the intracranial tension was extreme, and those in which there were signs of meningitis or encephalitis.

The opportunity to follow the development of German lines of thought in connection with the subject of gunshot wounds of the head is necessarily limited. I will refer to a report of von Eiselsberg to the German Surgical Congress in 1916, in which he said that the treatment of head cases did not belong in most instances to the surgeon at the front for reasons that we have already emphasized; he practised at that time universal drainage, approved the general principle that all foreign bodies should be removed because they are potential sources of abscess formation, and offered the following conclusions:

1. The most important and most dangerous complications of gunshot of the skull are, after the primary disturbances, the inflammatory processes of the brain and its meninges. Brain abscesses are always to be operated. In brain softening and meningitis, an operative attack is almost hopeless, and the same holds true for prolapse, except those caused by abscess.

2. All tangential gunshots, which show general clinical symptoms or local symptoms, or show no tendency toward improvement, are, especially if the x-ray shows positive findings, to be operated.

3. Through-and-through gunshots in certain cases are better not operated. If operated, the attack should only be made in the attempt to prevent progressive inflammation and infection.

¹⁴ British Journal of Surgery, 1916, ii, 474.

¹⁵ Deutsch. med. Wchnschr., xli, 607.

¹⁶ Beitr. z. klin. Chir., 1916, c, Kriegschir. Heft., 73.

4. Projectiles lying superficially should be removed. The deep-lying one should be operated if the patient develops symptoms. The *x*-rays are an invaluable help. When the projectiles heal in the depths without symptoms, then one must determine according to their location whether or not operation is to be done.

5. Epilepsy, which occurs in connection with a defect in the skull, should first be handled by internal medicaments, and only when this is without result, and at a later time, can they be operated. At later operation, through interposition of fat or celluloid plates, one can attempt to cure the epilepsy.

6. With the attempts at repair of skull defects, one should wait at least half a year after the subsidence of inflammatory symptoms.

7. All patients with gunshots of the skull should be under careful observation for a long time after complete wound healing, and, whenever possible, they should not be discharged, but kept in military hospitals, in order that they may be protected should the development of late abscesses and epilepsy occur.

8. Patients with gunshot injuries of the skull, in which the brain has been injured, should almost without exception be eventually discharged, unfit for service.

The only available contributions for 1917 germane to this subject, in German literature, are those of Perls and Joseph¹⁷ respectively. The latter had come to the conclusion, and this is rather a reversal of German thought and practice in the earlier stages of the war, that operations are not to be practised at the front unless (and these reasons seem to be universal) the opportunity for a thorough examination is afforded and early evacuation can be avoided. He makes the rather significant statement that an incomplete operation at the front is worse than no operation at all, and when, because of the incompleteness of the first operation, a second operation was required, the patients usually died from infection. He does not approve of deep drainage into the brain substance. Perls dwells particularly upon the late effects of trauma. He describes the pathology of healed cases and shows the probable relationship between this and the development of epilepsy. He has never found, although the history implied at the time of the accident loss of substance, a defect in brain substance beneath the scalp. This he explains on the ground that the brain prolapses into the space formerly occupied by the substance lost. Recovery from motor or sensory disturbances he attributes to the assumption of additional function by other cells.

Tolerance of Bullets. The presence in the brain of large foreign bodies is sometimes so well tolerated that their removal need not be considered. Marie¹⁸ presented the radiographs of 31 injuries of the head in which the bullet in the brain was not only well tolerated but in about three-fourths of the cases the bearer was not even aware of its presence. Marie therefore disapproves of exploratory operations on the ground that the presence of the missile is less dangerous than the operation for its removal. That this tolerance is more apparent than real is pointed out

¹⁷ Beitr. z. klin. Chir., March, 1917, Bd. vii.

¹⁸ Bull. et mém. Soc. de chir. de Paris, 1916, xlii.

by Villandre,¹⁹ an opinion shared by other observers as well. Villandre, in a series of 20 cases with "tolerated intracranial bodies," observed secondary phenomena directly traceable to the foreign body in 10 cases. The sequelæ included fistula in 3 cases, abscess in 3, Jacksonian epilepsy in 3, hemianopsia in 1, and 2 deaths. In one of the fatal cases, the abscess developed one year after the injury. Villandre therefore favors the removal of these foreign bodies on account of their inherent danger of carrying a latent infection, which may flare up only after a considerable period of apparent toleration.

Technic for Removal of Bullets. An unusual location of a bullet which had lodged between the atlas and the base of the skull, gave Kanavel²⁰ the opportunity to apply a novel technic for its removal through the mouth. After waiting eight weeks for the painful symptoms to subside, operation was decided upon. Stereoscopic pictures located the bullet one-half inch to the right of the median line on the anterior surface of the dura between the atlas and the base of the skull. The only clear picture obtained was an anteroposterior with the head thrown back and the mouth wide open. From this it was seen that the bullet could not be removed from a lateral approach or by the pharyngeal method. With the patient under anesthesia and the head thrown far back, rubber tubes were introduced through the nostrils and the two ends brought out through the mouth, so that the soft palate could be held out of the way and the vault of the pharynx exposed. An incision about one-half inch in length was made to the right of the median line just behind and parallel to the posterior pillar on the right side and on a line with the atlas. The muscular and connective tissues were separated by blunt dissection down to the bone and the tract of the bullet identified, but the bullet could not be seen. A silver wire was then introduced to the depth of the wound, and, with the aid of a fluoroscope, the relation of the bullet to the wire was seen. Resuming the operation it was found that the bullet had lodged in a pocket behind the upper part of the atlas, so that at times it lay between the atlas and the base of the skull and again in a pocket to the inner side of the atlas. Finally, it was found at a depth of three and a half inches from the surface of the mucous membrane, and, after removal, the wound was painted with tincture of iodine and tamponed with gauze. The operation, though tedious, presented no unusual difficulty, was unattended by hemorrhage, and no important structures were encountered. Aside from the rather remote possibility of meningitis, the method would appear to be useful for removing foreign bodies from that portion of the pharynx in front of the first four cervical vertebrae. Adequate drainage should avoid infection. The post-operative course was uneventful except for a rise in temperature (102° F.) on the third day and swelling of the nose and face, probably due to traumatism. The symptoms subsided promptly. The gauze was removed in twenty-four hours and the patient left the hospital in ten days, entirely relieved of pain.

¹⁹ *Jour. de méd. et de chir. prat.*, 1917, lxxvii, 129.

²⁰ *Surgical Clinic, Chicago*, 1917, i, 361.

The *technic for the removal of an intrahemispheric foreign body* by means of a paramedian exposure, without involving the brain substance, is described by Patel.²¹ The radiograph, with both anteroposterior and lateral exposures, is indispensable for localizing the missile in its relation to the median line and the cranial vault on a horizontal plane passing through the foreign body. In regard to its relation to the median line, in cases of doubt it is well to remember Areclin's observation that the missile always lodges on the same side as its point of entrance, being arrested by the first obstacle, in this case the falx.

In case of a foreign body on a lower plane, it is sometimes difficult to tell whether the bullet lodged in the cerebral or cerebellar hemispheres. There are two ways of determining this: (1) By viewing its location with reference to the line of the lateral sinus. This extends from the external occipital protuberance to the upper border of the posterior margin of the mastoid process; the plane above this is cerebral and that below cerebellar. (2) The other is based on the presence of the tentorium cerebelli. This membrane offers so much resistance to the bullet that the chances are that a bullet entering the brain and lodging near the space between the cerebral and cerebellar hemispheres would eventually lodge rather on the cerebral than on the cerebellar side of the tentorium.

The symptoms of intrahemispherical foreign bodies present no special features. They rarely reach their destination without injuring the brain substance, and according to the region traversed will the symptoms be more or less marked and distinguishing. In two of Patel's cases there was a total crossed hemiplegia in one, but no cerebral or psychic symptoms in the other. The missile became encysted in a fibrous wall and the cortex thus escaped direct irritation. Noteworthy was the absence of the late effects of infection; vascular complications are more likely to occur, as in one case in which perforation of the wall of the torcular herophili gave rise to profuse hemorrhage.

The technic of removing intrahemispherical foreign bodies differs entirely from that of removing a bullet within the hemispheres. In the first place, from the stand-point of localization, the cerebral falx serves as a very convenient and reliable guide, and, by following the falx, injury to the brain is avoided. The skull is opened with an osteoplastic flap, or with a trephine, 1 or 2 centimeters to one side of the median line to avoid the superior longitudinal sinus, either at the vertex or 3 centimeters more posteriorly. A crucial incision is made in the dura, and, with a flat retractor, the internal surface of the hemisphere is exposed. The missile is then searched for with the finger and removed with forceps.

Longitudinal Sinus Injuries. A definite syndrome has been attached by Holmes and Sargent²² to injuries to the superior longitudinal sinus. This comprises spastic paralysis of the legs, often accompanied by spastic paresis of the proximal segment of the upper limbs. The superior longitudinal sinus, or the veins entering it, are occluded as a result of a

²¹ Bull. et mém. Soc. de chir de Paris, 1917, xliii, 1154.

²² British Medical Journal, ii, 494.

depressed fracture of the vertex of the skull. Operation in these cases is apparently contra-indicated, as there were 15 deaths among 39 operations (by the authors or others); on the other hand, only 1 death occurred among 37 unoperated cases. While some allowance should be made for the fact that only the severe cases were selected for operation, and that, among the fatalities, 7 presented other direct injuries to the brain, the figures nevertheless indicate the greater risk of operation. In addition to this, the uncomplicated cases showed a marked tendency to spontaneous improvement, in all probability due to the reestablishment of the circulation resulting from a free venous anastomosis. Saviozzi²³ reports 4 cases of involvement of the longitudinal sinus among 66 patients with skull or brain lesions. None of the former survived the operation, 2 dying of profuse hemorrhage during the operation, and the other 2 forty-five hours and eight days, respectively, after the operation. The symptoms included loss of consciousness, with incontinence of feces in some instances, Rolandic symptoms (tetraparesis and tetraspasm), and in 1 case indications of associated lesions of both parietal lobes. Saviozzi endeavored to control the profuse hemorrhage by means of ligatures and doubts whether any better results would have obtained from the use of gauze tamponage.

ANESTHESIA. I might insert in the discussion at this point a word or two as to anesthesia, or rather the choice of anesthetic. In many head cases the profound unconsciousness enables the operation to be carried out without the aid of any anesthetic, but, in the remaining, there is a difference of opinion as to whether general or local anesthesia is preferable. Reviewing the various commentaries on the subject, I find a majority of surgeons prone to dispense with a general anesthetic whenever possible, but this opinion applies chiefly to the operations performed near the front, where shock has to be reckoned with.

There is nothing in the operation *per se* or in the nature of a head injury that should constitute a contra-indication to ether narcosis. There may be reasons other than shock which influence the surgeon in his preference for local anesthesia, but they are not apparent. As a matter of fact, however, operations upon the brain rather lend themselves to local anesthesia. Having passed through the scalp and pericranium, the remaining tissues can be traversed without the aid of any analgesic agency. The skull itself is quite insensitive, the dura only slightly sensitive, and the brain within its bony encasement has no need of a sensory system for its defense; so that if there be any substantial reason for using local anesthesia, the operative field is peculiarly adapted to it.

Hernia Cerebri. To say that hernia is a common complication of gunshot wounds of the head hardly gives one the impression of how frequently it has to be dealt with as an immediate emergency and how many soldiers are paroled home with a hernia of smaller or larger dimensions. The figures have escaped me, but the reports of the British surgeons as to the incidence of hernia cerebri among the returning troops

quite staggered me. It has therefore been given a great deal of consideration, as to the method of prevention, as to the method of dealing with the hernia as an acute and life-endangering process, and from the standpoint of its control in the postconvalescent stage by the repair of the defect in the skull.

In the consideration of operative measures for the relief of hernia, Smith²⁴ calls attention to the special tendency of exposed brain substance to ulcerate and slough off. For this reason he urges against enlarging the dural opening already produced by the wound, and also against incising the intact dura, in order to avoid creating conditions favorable to the development of hernia. He also emphasizes the value of gravity in the prevention, as well as in the treatment, of this complication, and, whenever possible, he has the patient in a sitting position after operation. Unfortunately, this can be done in only a limited number of cases. The free use of sedatives—morphine or heroine—keeps the patient quiet and thus avoids the possible bruising of the hernia. If protruding to any extent, it should be surrounded by a large wool buffer for protection. Smith has found lumbar puncture of the utmost value in the treatment of hernia. The fluid must be withdrawn slowly since the too sudden relief of pressure may cause the hernia to sink back through the bony opening, break up adhesions and induce a septic meningitis. The operation may be repeated on alternate days when the symptoms do not abate, and, in exceptional instances, with signs of rapidly increasing hernia and progressive signs of compression, it may be done daily. If the fluid returns clear, it may generally be assumed that there is no inflammation and the interval may then be increased. At the same time, attention is called to the fact that a clear fluid does not always indicate the absence of a meningitis, since at autopsies a suppurative meningitis has often been found when the cerebrospinal fluid was clear.

Rawling²⁵ describes three types of cerebral hernia, aseptic, septic and fungus of the brain. The aseptic type results when the explosive effect of a bullet, portions of the skull being carried away (the brain being left intact), causes increased intracranial pressure. The increase in pressure may be due to hemorrhage, venous engorgement or edema, and the brain substance which protrudes, being uninjured and aseptic, is normal in appearance. A true septic cerebral hernia, on the other hand, implies extensive destruction of bone with laceration of the dura, and infection of the brain substance from fragments of bone or missiles. The degree of intracranial pressure is greater than in the aseptic variety. The protruding mass is usually red, granular, pulsating, and slightly constricted at its base, and there is usually superficial suppuration. In fungus of the brain, the brain herniates through a small opening in the dura, the constriction at the neck of the hernia interferes with the venous return and there results venous engorgement and cerebrospinal edema and consequent increased pressure. With the addition of foreign bodies, such as fragments of bone and bullets, the tendency to hernia is all the greater.

²⁴ British Medical Journal, 1916, ii, 102.

²⁵ Surgery of the Head, Oxford, 1915.

This sufficiently explains the frequency of this condition in war wounds of the head. As the protruded portion increases in size, the venous engorgement becomes more pronounced, and a vicious circle is established, analogous to the conditions in strangulated hernia. The fungus appears as a moist, cauliflower mass, bleeding freely, but with little pulsation, but a free, purulent discharge. Any attempt at reduction, because of the narrow opening in the dura, will be futile, differing in this respect from the septic hernia where the hernia can be partially reduced, although in doing so one may cause symptoms of compression, such as headaches, loss of consciousness and epileptic seizures. In fungus, there are certain alterations in the brain beneath the dura; it becomes congested, edematous and soft. Sometimes the fungated mass contains the horn of the dilated ventricle, and occasionally the latter may rupture and discharge on the surface.

In the *treatment of the various forms of hernia*, Rawling suggests, for the first type, keeping the exposed brain clean, first by washing with hydrogen peroxide and saline fomentations renewed every two hours, and when the surface is clean substituting boric acid powder and dry dressing. With the daily renewal of dressing the surface may be painted with iodine. In obstinate cases the hernia may be painted every third day with a 10 per cent. solution of formalin. This will cause the tissues to necrose and dry up, but as the function of the brain contained within the hernia has already been destroyed, no greater damage is done. Lumbar puncture will favor the recession of the hernia, and, if the proliferation of skin from the margins takes place too slowly, healing may be expedited by skin grafts.

In the second type, the subsequent increase of the hernia may be due to contained infected foreign bodies which, in turn, give rise to a cerebritis or even an abscess. Under such circumstances, the foreign body should be removed, if possible, or the abscess drained. If, after this, the hernia still persists, the surface may be painted with formalin or with alcohol every third day, and on the intervening days with a 2 per cent. solution of tincture of iodine. As a last resort, Rawling suggests shaving off the protrusion, although this grows again and, unfortunately, too, may contain the expanded and dilated horn of the lateral ventricle, so that the region is exposed to direct infection and the free escape of cerebrospinal fluid. After shaving the mass flush with the surface of the skull, bleeding is controlled by the immediate application of dressings and pressure bandage. He applied the method successfully to three instances. Finally, if necessary, a contralateral decompression may be undertaken over the opposite temporosphenoidal lobe, and should be free, both as regards the dura and the bone. After this operation, more pressure may be applied to the hernia than before, because the decompressive opening permits of the protrusion at another place. The end-result will depend on the cortical region involved, as the function of the herniated portion is impaired or lost; naturally, therefore, the most serious effects follow hernia of the Rolandic and occipital regions.

The third type, fungus of the brain, represents a very serious condi-

tion. After shaving the hernia, the entire region should be sponged with iodine, and a director introduced for a short distance beneath the dura and the membrane slit up freely in several directions. This should release the strangulation at the neck of the hernia. Meningeal infection occurs less often than one might anticipate. The "swollen" brain being in contact with the dura, the subdural space is obliterated and adhesions form rapidly and constitute a "fairly efficient barrier" to the spread of infection to the meninges. Sargent, quoted by Makins,²⁶ does not follow the classification of Rawlings, which seems to me not altogether practicable, but includes under the term "fungus" all cases of an infective, edematous protrusion of the brain matter, a condition that prevails almost universally when the brain protrudes after a gunshot injury with destruction of bone and dura. The term "hernia" he reserves very properly for the protrusion of an uninjured brain through a deliberately made opening. His conception of the pathology of fungus or septic hernia corresponds with that with which we are familiar. He emphasizes the danger of attempting, by lumbar puncture within the first twenty-four to forty-eight hours, to reduce the fungus because of the likelihood of producing vertical meningitis. Fragments must be removed with care to avoid breaking up adhesions and opening the ventricle. Suspected abscess cavities should be explored and drained. After this lumbar puncture should be practised daily or on alternate days, removing not more than four to six drams of fluid. Should this fail a contralateral decompression may be resorted to.

Cranioplasty. The European War has provided opportunities for studying and practising variations and modifications of technic on a large scale. This has been true notably, of course, of infected wounds and of compound fractures, of traumatic aneurisms, of peripheral nerve injuries, of penetrating wounds of the lung, and many have been the important, and, in many instances, truly startling advances that have been made in the surgical treatment of these war injuries.

As a further example of a war-bred surgical opportunity, I might include innumerable cranial defects. In fact, by far the majority of head injuries require secondary operations for the repair of defects. Hitherto the most acceptable method in my hands has been a modification of the König-Müller use of the external table of the skull, an autoplasmic or bone graft with *pericranium attached*, but without a pedicle. It will be seen, however, in the discussion that follows, that a great variety of methods have been used, including autoplasmic bone grafts from skull, tibia or scapula; homoplasmic bone grafts from the skulls of the dead; heteroplasmic grafts as from the scapula of rabbits, cartilaginous grafts, which have grown in popularity; and foreign material, such as ivory or silver plate. The advantages of the cartilaginous graft are many, and may be summed up as follows: The grafts are readily obtained and may be removed from another person as long as a month before using; they are readily cut with scissors to the desired size and shape with extreme precision. Cartilage lives indefinitely without being

²⁶ British Journal of Surgery, 1916, p. 263.

absorbed, without appreciable diminution in size, and adapts itself with great rapidity to its new surroundings. Thus far, however, there is no evidence to show that the cartilage undergoes ossification.

The general principles underlying the technic, as described by various operators, are those which I have found essential to success. The edges of the defect are freshened, and adhesions to the underlying cicatrix freed. I have always been in the habit of excising the cicatrix, which usually includes the dura, although Axhausen shaves it layer by layer until pulsation is restored and then stops. The graft should be cut to fit the defect as accurately as possible. I have usually anchored it in place with a few interrupted sutures through the pericranium. Others do not anchor it at all; some insert it beneath the edges of the pericranium and some use a trellis of catgut sutures. It has been my practice to expose the defect by a large flap, others through an incision which removes the original scar. The latter practice I believe has certain disadvantages and few advantages. Hemostasis is regarded by all as a *sine qua non*, and, if necessary to secure a dry wound, drainage should be employed.

As to the time for operation, this depends somewhat whether there are any cerebral complications. With increasing paralysis, or with the slightest suspicion of abscess, the operation should be postponed indefinitely. Without cerebral complications, the operation may be performed a few weeks after the wound has healed. There is no objection, so far as I can see, to a general anesthetic, although the operation can be performed under local anesthesia. The secondary hemorrhage after the latter is, however, an objectionable feature. The indications for operation are usually a train of subjective phenomena, as headache, vertigo, and the fear of injury to the brain. Epilepsy should be regarded as an indication for early operative treatment.

At the Paris meeting²⁷ this question was discussed by Morestin, Gosset, and others. It was the general consensus of opinion that cranioplasty should not be undertaken until some time after the wound had healed and further observation eliminated the likelihood of latent infection or any condition contra-indicating operation. In a number of instances, Morestin advises a preliminary operation, at which, by plastic methods, the adherent cicatrix is removed. In fact, in some cases it may be advisable at all events to remove the scar in several stages. The transplant should not be made until there is every reason to believe that the cutaneous wound can be closed without traction and the conditions for wound repair are favorable. The concluding operation, the cranioplasty, together with the removal of the transplant, can always be done under local anesthesia. Although any cartilage may be used, Morestin prefers to use the costal cartilage between the 6th, 7th or 8th ribs, exposing it by a 9 to 10 cm. incision around the costal margin on one or the other side. One need not be parsimonious as to the size of the graft removed, since there is no part of the body from which a transplant can be taken with greater impunity. After the graft has been removed,

²⁷ Loc. cit., p. 1593.

it is placed in an aseptic compress, and the wound closed without drainage. As to the incision, Morestin does not approve of including the original crucial scar in a flap, but follows the line of the old incision. After reflecting the cutaneous flaps, he explores the defect, exposes its margins and fashions his transplant according to the size and shape of the defect. In some cases the graft may represent only part of the entire thickness, being removed in layers; in others, it is composed of the entire thickness of the cartilage. Transplants still covered with perichondrium should be placed with the latter turned toward the inside. The cartilage need not be fixed by suture or otherwise—it suffices merely to fill in the defect, obliterate all dead spaces and close the wound. Primary union is the rule. Occasionally it may be necessary to add a small graft to the main one, and this can be done by insinuating thin pieces between the dura and the internal surface of the brain.

The wound should be closed hermetically. The results are most satisfactory. Recovery in three or four days is the rule, and there are rarely any complications. The fragments of cartilage unite with one another and with the defect, providing a protection almost as resistant and solid as the skull. In the majority of cases the margins around the defect are scarcely visible, so that, from an esthetic point of view also, the operation is satisfactory to the patient.

Gosset,²⁸ through his experience with 32 operations (2 deaths in the first 20 cases), concludes that cranioplasty is indicated for defects of the skull with, or without, the dura intact, and especially when there follows the immediate recovery certain subjective disturbances, such as headaches or pulsation.

He also prefers the costal cartilage, and his technic differs according to the exigencies of the case. Where there is no tendency to hernia, he merely inserts the margins of the graft between the dura and the skull, the perichondrium being turned toward the inside. He finds it more advantageous to have the cerebral substance in contact with the smooth surface of the perichondrium than with the more or less irregular surface of the cartilage. In order to avoid incurving of the cartilage, the graft is introduced into the bony breach in the manner of a watch-crystal, its very thin margins, as thin as a finger-nail, completely deprived of perichondrium, being placed between the dura and the bone while the rest curves out and leaves sufficient room for the brain.

With Mme. Dejerine and M. Mouzon, Gosset devised a technic particularly applicable to cases where there is a tendency to hernia. The graft is shaped like the cork of a champagne bottle, the uniform surface is placed in the defect and the expanded portion rests on the outside. This eliminates the risk of compression and any external pressure merely serves to fix the graft in the defect.

In one instance, Gosset shaped the cartilage to conform exactly to the size and shape of the defect, and kept it in place by means of prolongations which correspond to small grooves on the bone defect. Gosset advises drainage for at least twenty-four hours after the operation.

²⁸ Bull. et mém. Soc. de chir. de Paris, 1916, xlii, 1600.

Woodroffe²⁹ recommends the repair of the defect also with a cartilaginous graft, when the patient complains of headache, vertigo, sudden blurring of vision, especially when brought about by sudden movement, inability to sleep unless the head is raised or tightly bandaged, or great sensitiveness to noise. He takes the graft from the 7th, 8th and 9th ribs, shaves the cartilages to about half their thickness, and is careful not to cut through the entire thickness of a fixed cartilage, although the entire tip of a floating one may be used. The graft, which should be generous in size, is kept in warm saline solution until needed. For placing the graft, he makes a crucial incision over the defect, frees the margins of the bone defect from the dura, freshens the edges with a rongeur, places a swab of hydrogen peroxide in the wound and turns the flaps back over it. He rarely finds it necessary to open the dura. For keeping the flaps in place, he uses the following modification of Morestin's method devised by Villandre.³⁰ One end of a fine catgut stitch is passed through the pericranium and tied, after which it is passed through the pericranium on the other side of the breach and taken backward and forward in a zig-zag manner until the hole is covered in with a trellis. If the gap is a very large one, this network should be supplemented by another at right angles to it and the graft insinuated between the two layers. Into this smaller chamber, bounded by the dura, the edges of the skull and the trellis, the grafts can then be slipped with forceps. Adhesions are avoided by applying the perichondral surface to the dura; this is also the easier way, since, like bone grafts, cartilaginous grafts curl when cut and the perichondrium is on the concave surface. The grafts should overlap one another and may even be applied double in order to allow for the slight recession which always takes place. The cases which, at the end of the operation, show a slight boss always give the best results. He uses, for drainage, strands of silkworm gut. The wound in the thorax is closed in layers by an assistant while the surgeon closes the head wound. The thoracic wound is apt to be painful at first, and, to control this, morphine and atropine should be given as soon as the patient recovers consciousness. Woodroffe prefers deep narcosis for cutting the graft, and the rest of the operation is carried out under light anesthesia. At the end of a week the defect is usually firm, though elastic, and dressings may then be discontinued.

X-ray studies several months after the operation have proven that the graft does not ossify but remains cartilaginous.

Sicard,³¹ at the Paris symposium, reported one case in which he was obliged to remove a graft at the end of four months because of the absence of any sign of ossification or even calcification. The line of demarcation between bone and cartilage was perfectly clear, the two being firmly united by fibrous tissue.

Sicard and Dambrin³² employed human cranial bones taken from recent autopsies, removing the graft from the same region as that of the defect. When boiled for two or three hours, the transplant becomes

²⁹ British Journal of Surgery, 1917, ii, 42.

³¹ Loc. cit., 1610.

³² Presse méd., September 11, 1916.

³³ Presse méd., 1917, xxv, 60.

pliable enough to conform to the shape. The graft is sterilized by immersion in pure ether for twenty-four hours, for a similar period in ether and alcohol, and finally subject to moist heat at 120° for one-half hour (the temperature should not be above this, otherwise the bone will soften). The bone is then tested in bouillon, and, if the fluid remains clear, the graft is suitable for use. It is then fitted to the defect in the manner of a watch-crystal, sutured and reinforced so far as possible with periosteum from the surrounding area. The method was tried on 9 cases with perfect results, the longest period after operation being, at the time of writing, seven months. Their clinical work was preceded by a series of anatomical experiments in which it was found that after seven months the grafts were covered with a dense fibromuscular membrane. Intimate union had taken place between the graft and the defect, and the authors were inclined to believe that the result on the human subject would be even more satisfactory.

In a ten months' experience, which included 106 plastic operations, Villandre³³ did not find sterilized human bone as satisfactory as other material. According to his statistics, the osteoperiostic graft was successful in 100 per cent., the cartilaginous graft in 96.8 per cent., sterilized bone in 81.8 per cent., and a synthetic graft made of salts of phosphate and carbonate and sterilized olive oil in 50 per cent. There were no deaths in the entire series. Grafts of living tissue, bone or cartilage, taken from the subject himself at a distance from the site of the cranial lesion, seem to be the most practical and the most successful. For small grafts, not more than 3 to 3.5 cm. in diameter, Villandre used bone taken either from the human skull or ribs or from the skull and the iliac bones of sheep, and sterilized them in the autoclave at 130° without any other preparation. The now pliable bone is easily cut to the desired shape and size, is introduced into the defect and held in place by a precranial suture in the shape of the letter U. There were 4 cases in which this graft caused trouble. In one, a rise of temperature and slow pulse led to the removal of the graft and the discovery of a small abscess; evacuation of the abscess was followed by recovery. In another, the bone had crumbled into several fragments, one of which had caused compression and symptoms of Jacksonian epilepsy. Recovery followed the removal of the fragments. In two other instances, the bone graft was not tolerated and had to be removed after two or three months. All the patients suffered more or less from severe headache for eight to fifteen days or longer, which was not the case when living tissue—osteoperiostic or cartilaginous—was used.

Villandre³⁴ employed osteoperiostic grafts from the tibia. The pericranium is exposed around the defect sufficiently to enable the graft to be inserted easily between the dura and the skull. The size of the defect should be carefully measured. The tibia is exposed and the internal, superior and inferior boundaries of the transplant outlined by two transverse incisions and one longitudinal incision, the external boundary is indicated by an incision into the aponeurosis down to its

³³ Presse méd., 1917, xxv, 300.

³⁴ Ibid., 1917, p. 540.

insertion. With an ordinary chisel held almost perpendicularly, the graft to a thickness of 1 or 2 mm. is separated with a slight oblique movement. In this maneuver care should be taken to avoid injury to the periosteum and that the graft is completely circumscribed on three sides. The final separation is made with a flat Farabeuf chisel introduced into the groove, carefully detaching the tibialis anticus muscle. The leg is then rotated inward and a few short strokes applied, the chisel is then inserted first above, then below. The thickness of the tibial cortex being 4 to 7 mm. and that of the graft never more than 3 mm., the Farabeuf chisel will rarely enter the bone marrow.

The graft is then fashioned to conform exactly to the defect and is slipped under the pericranium. The periosteum should always be turned toward the dura. Sutures are rarely required to keep the graft in place, since it becomes firmly attached at the end of five or six days. The procedure, Villandre believes, is more simple than that required for obtaining cartilaginous grafts, and provides a solid material which does not become displaced.

Mayet³⁵ takes the graft from a portion of the external table of the skull, fashioned so as to correspond exactly to the shape of the cranial defect but a little larger. The external table covered with periosteum is completely detached only on three sides, and reflected over the defect. By this flap method the graft maintains its vascular supply and will soon unite to the margins of the defect. The graft is well nourished and shows a tendency to hypertrophy, while the area from which the graft was taken is soon repaired.

The technic of obtaining the graft is described as follows: After inspection of the defect and measuring its size, the periosteum is incised around the margins of the prospective graft, which should be a little larger than the defect. The periosteum is incised only on three sides, care being taken not to detach it. The separation of the external table is a much easier procedure than is generally believed, especially in adult patients below the fortieth year. It can be done with a large chisel directed obliquely from the side toward the center.

Some of the complications are pointed out by Besta and Bossi.³⁶ Two out of seven operations were attended with a fracture of the tibia, and in others the wounds became infected. Bossi, on two occasions, used the scapula of a rabbit. The operation was followed on the fourth day by edema of the forehead and the eyelid, and an examination of the urine revealed albumin in 1 case and sugar in another. The edema and the urinary disturbances disappeared within ten days. Bossi attributed these phenomena to the presence of muscle tissue and periosteum on the bony transplant, and in the next operation was careful to remove these tissues. Although the same symptoms appeared they were only transitory.

Devèze,³⁷ while dissecting out the scar, preparatory to transferring the cartilage, injured the torcular herophili. The hemorrhage, though profuse, was controlled by simple tamponage. The gauze was removed

³⁵ *Paris Chir.*, 1916, viii, 105.
Mont. méd., 1917, xxxix, 668.

³⁶ *Policlinico*, 1917, xxiv, sez. prat., 801.

piecemeal over a period of twenty days, and while a portion of the graft came away with the gauze, there was enough left to repair the defect.

Some surgeons have been successful with plates of fenestrated ivory, but, as this is rather expensive, its use will be limited. Two experiences with the material are reported by Walch,³⁸ and it is interesting to note that Mauclore, who reports Walch's cases, is himself the bearer of one of these plates, which he has tolerated without any inconvenience for eight months.

Among the English, we find Noon and Mitchell advocating the use of metal plates. Noon³⁹ makes a semilunar incision, with its base below, and fashions the flap so as to expose the defect, with a margin of about one and a half inches of skull surrounding it. The flap is freed down to the periosteum for about three-quarters of an inch at its margins, but the balance includes the periosteum. The flap is then covered with gauze and hot saline solution at 118° F. poured over it to control oozing. The margins of the periosteum are then separated from the bone, and the metal plate, previously cut to the required shape, is passed under it, pressed down flat on the skull, and fixed in position with catgut sutures. If necessary, a drainage tube is inserted at one angle of the wound, the dressing is applied with firm pressure, the drainage tube is removed in forty-eight hours and the stitches on the tenth day.

Mitchell⁴⁰ uses a perforated silver plate rolled out a little thinner than an ordinary visiting card and punched with holes as closely as possible. The thin plate makes it readily adaptable to the shape of the skull and the perforations reduce the weight and permit the escape of blood, and thus avoiding the danger of compression by accumulation between the plate and the dura or the brain, at the same time providing a convenient means of attaching the plate. He turns down a large flap and explores the defect for foreign bodies or adhesions, which, of course, should be removed. The periosteum is then carefully separated from the margin of the opening for about half an inch, and the plate, having been cut about one-half inch larger than the defect, is then slipped under the reflected periosteum and fixed in position by a series of catgut sutures in and out through the periosteum and the perforations in the plate. The flap is then sutured in position and a drainage-tube inserted at the most dependent angle, to be removed in twenty-four hours. Primary union took place in all of 6 cases in which this method was used.

While the cosmetic and the immediate psychic results of one or the other of the methods just described are usually satisfactory, it is difficult to ascertain the more remote results. In the nature of these cases, the vast majority are lost sight of, and the reports of end-results rarely indicate the amount of time that has elapsed between the operation and the observations. Pierre Marie (reported by Mauclore, *loc. cit.*) examined 21 cases in regard to cerebral function, and, of these, he found 6 improved with only partial disappearance of the subjective symptoms, 12 were unimproved, and in 3 the subjective symptoms had been

³⁸ Bull. et mém. Soc. de chir. de Paris, 1916, xlii, 2031.

³⁹ Lancet, 1917, i, 373.

⁴⁰ British Journal of Surgery, 1917, v, 40.

aggravated. Claude and Sicard⁴¹ have been obliged to reoperate some of their cases, while others, including Morestin, Delagenière, Gosset and Mauclore, record improvement, especially in the ability of the patient to stoop forward without accompanying vertigo.

While there is a tendency to cerebral hernia, Mauclore⁴² advises against repair of a defect. He finds it best to test these cases by slight and prolonged compression over the defect to see whether or not the condition is aggravated, and by lumbar puncture he studies the tension of the cerebrospinal fluid. Any signs of hypertension should be regarded as a contra-indication to cranioplasty.

Radiotherapy for the Relief of Meningeal and Cerebral Lesions. Radiotherapy has accomplished many unexpected things, and no doubt, many conditions which it might favorably influence are still unrevealed. We are, of course, familiar with its effect upon scar tissue, as illustrated by the gradual disappearance of large keloids, but that this principle might be applied to pathological lesions of the central nervous system had never occurred to me, and even after reading the report of Bonus, Chartier and Rose⁴³ I am not altogether convinced. They applied radiotherapy for the relief of all sorts of symptoms, such as radiating pains around the scar, neuralgia, vertigo, and unequal pupillary action. Of 14 cases, one was said to be completely cured, the unlucky 13th only markedly improved. One case of Jacksonian epilepsy and one of reflex epilepsy were entirely relieved. Improvement of symptoms resulted in one case of spastic paralysis. The rays should be hard and penetrating, the time exposure depending on the depths of the affected region. The favorable effects may be explained by the absorptive action of the x-rays on scar tissue. In meningeal lesions this would tend to remove adhesions, and, in cerebral lesions, cicatricial tissue.

END-RESULTS. The end-results of gunshot wounds of the head are, on the whole, encouraging, judging from the observations of Sargent and Holmes⁴⁴ of 1239 patients in the hospitals of London and its vicinity. The early paralyses, sensory disturbances, etc., they point out, are due, not so much to the destruction of brain tissue, as to concussion, edema and vascular disturbances, and like similar disturbances in injury to the cord. The symptoms subside and disappear in the course of time. Even in the cases in which the symptoms were persistent, owing to actual destruction of brain tissue, the improvement in some cases was surprising. A small percentage with perforating and penetrating wounds of the skull, with resultant paralysis, sensory disturbance, hemianopsia, etc., were so improved as to be fit for renewed service at the front, while others were able to take up lucrative occupations. While improvement in these cases is naturally low, on the whole it may reasonably be expected that a considerable number of head injuries will be able to return to active and useful civil life.

Insanity is a much less common result of war injuries to the head than is generally supposed. In the Napsbury War Hospital, to which all cases with mental symptoms resulting from war injuries are sent for observa-

⁴¹ Loc. cit.

⁴² Loc. cit.

⁴³ Lyon méd., 1917, cxxvi, 233.

⁴⁴ Journal of the Royal Army Medical Corps, 1916, xxvii, 300.

tion, only 8 patients with head injuries were admitted during a period of twelve months, only 2 of which proved to be actual cases of insanity. Out of a total of 37 cases, epilepsy was observed in only 6 per cent., in which the notes were complete, only 11 had had frequent convulsions and 8 Jacksonian epilepsy. The administration of bromides sufficed to control the seizures in the majority of the cases, and the authors recommend the administration of this sedative in all serious cases of head injuries, not only until the wound is healed, but for some months afterward.

MacAuliffe and Card,⁴⁵ discussing the persistence of symptoms after concussion, record the following: Tachycardia, 72 per cent.; bradycardia, 16 per cent.; diminished sexual powers, 36 per cent.; ocular symptoms, chiefly restriction of the visual field, 56 per cent.; reduced vision, 64 per cent. (bilateral in 62 per cent.); auditory symptoms, including defective hearing (most common, nystagmus, spontaneous or induced), 48 per cent. In most cases, however, the prognosis is favorable for complete disappearance of the symptoms in the course of time.

BLOOD-PRESSURE. Anent the persistence of symptoms after fracture of the skull, Robins⁴⁶ calls attention to the state of the *blood-pressure* as an important prognostic sign. A sudden change, especially a comparatively rapid drop in pressure, is an ominous sign and frequently presages death. In a case of fracture of the skull (in civil life), the patient was admitted to the Western Hospital with a blood-pressure of 178, which an hour later (when the operation was begun) had dropped to 120 and in another half-hour to 75, the pulse and respiration remaining practically unchanged. Within the next three minutes, the pulse disappeared and respiration ceased. Under artificial respiration, the blood-pressure dropped to 60, but death ensued after three-quarters of an hour of fruitless effort.

Ocular Phenomena in Intracranial Trauma. The recognition of ocular disturbances accompanying fracture of the skull is regarded by Cohen⁴⁷ as important both from a diagnostic and a prognostic point of view. He bases his conclusions on a study of 75 cases of fractured skull treated at the Harlem Hospital (New York), the diagnoses being confirmed by the x-rays or at autopsy. Simple contusions of the vertex and head injuries other than those with a fracture of the base or vertex, are not included in the study; nor are bullet wounds producing hemianopsia, direct paralysis of the extrinsic ocular muscles or pulsating exophthalmos. The study, therefore, is limited to the pupillary and fundus changes, such as venous stasis, papillitis, neuroretinitis, optic hemorrhage and changes in the visual field. He finds that inequality of the pupils, combined with bilateral loss of light reflex, is common in fatal cases of fractured skull and comparatively rare in non-fatal cases. Inequality of the pupils, associated with unilateral marked amblyopia or amaurosis in the eye in which the pupil is dilated, presents a possibility of future descending primary optic atrophy in that eye. Lesions of the fundus are not

⁴⁵ Bull. de l'Acad. de méd., 1917, lxvii, 566.

⁴⁶ Canada Medical Association Journal, 1917, vii, 529.

⁴⁷ Arch. Ophth., 1917, xlvi, 258.

frequent, especially in the cases that recover. Papillitis usually indicates meningitis, an increase in cerebral pressure or hemorrhage into the sheath of the optic nerve or its immediate vicinity. Choked disk was not observed in any of the cases, which is contrary to the usual observations. A unilateral optic atrophy, other causes being excluded, should lead to investigation as to a possible previous injury. This is important from a medicolegal point of view. Among the 75 cases there were 24 deaths from a few hours to a few days after the injury. The cause of death, in all but 3, was hemorrhage, and these died of meningitis, 2 on the sixth day and 1 a month after the accident. In the fatal cases the pupil was generally dilated on the same side as that of the hemorrhage.

Epilepsy a Sequel of Gunshot Wounds. It has been frequently observed that the incidence of epilepsy, as a sequel of gunshot wounds of the head during the present war, is not as great as was anticipated. By that I mean that the percentage of cases is low. Still, with such a huge number of traumatic injuries of the brain, even should the percentage be small, the number of epileptic subjects that will have to be provided for after the war becomes at once a problem of great magnitude from both the medical and sociological point of view. In discussing the subject, Buzzard⁴⁸ remarks that surgery is not curvative *per se*, but merely paves the way for better results from other therapeutic measures. The extent or severity of injury to the brain seems to have no relation whatever to the incidence of epilepsy. To account for the fact that some individuals develop epilepsy after intracranial injury and others do not, Buzzard advances the following hypothesis: We are all potentially epileptic, and differ only as to the ease with which the latent process is aroused. He hopes that the experience of the war will furnish statistics as to how far hereditary neuropathic or psychopathic tendencies act as predisposing factors in the development of epilepsy after head injuries.

As for treatment, after surgery, when indicated, has restored conditions at the site of the injury to as nearly normal as possible, bromides should be given persistently and systematically in the hope of "nipping these cases in the bud." Bromides should be administered as soon as possible in order to prevent the brain from acquiring the "habit of fits." In fact, Buzzard believes strongly in their prophylactic influence and administers bromide in some form in every case of head injury under his care, for a period of at least six months or even a year. Inasmuch as occupation for both mind and body is an important factor in the treatment of either the idiopathic or traumatic form of epilepsy, Buzzard suggests the establishment of governmental colonies under medical control for the purpose of segregating and caring for the large class of epileptic subjects that the war will be responsible for.

Perly,⁴⁹ in examining 53 cases returned to Munich, found 6 cases of epilepsy. Except when the injury was in the motor cortex, the convulsions were general in character, and he believes epilepsy results from the more or less continuous irritation of the cortex that must inevitably arise when, with adhesions at the site of the scar, the patient coughs,

⁴⁸ *Lancet*, 1916, ii, 1095.

⁴⁹ *Beitr. z. klin. Chir.*, March, 1917, p. 435.

strains or stoops, or even from the normal pulsation of the brain. What part pressure plays in the cause of epilepsy remains, to my mind, a matter of conjecture. Whether one believes it is due, as some contend, to increased pressure, or is itself a cause of increased pressure, will influence one in recommending the closure of defects. In half of the cases in which Perls closed the defect, the epileptic seizures were arrested. It may be here noted that the incidence of epilepsy is not related to the gravity of the wound, as it may follow comparatively trivial injuries.

THE PITUITARY BODY.

The development of the therapeutics of pituitary disorders is dependent to a certain extent upon experimental inquiries and upon the clinical results of glandular feeding and surgical interference. Up to the present time the experimental evidence is somewhat conflicting and contradictory, and research should be stimulated and continued until some uniformity of results are obtained.

The results of Bell's⁵⁰ experiments agree in many respects with those published by Cushing and Paulesco. He found that total extirpation caused death within a few hours; in the cases surviving a longer period, the extirpation was probably not complete. Since the removal of large portions of the pars anterior also caused death, loss of this portion must be held accountable for the fatalities after total extirpation. He differs from the above-named authors in his observations that removal of the pars anterior causes genital atrophy or that it may occur in the absence of any other symptoms. In no case of removal of the pars anterior did he see *dystrophia adiposogenitalis* supervene. The complete or the partial removal of the pars posterior did not produce any symptoms, the genitalia were not affected and the young animals continued to develop. The secretion of the pars nervosa, therefore, does not seem to be essential nor beneficial to life. Likewise, partial removal of the pars anterior and posterior produced no symptoms, provided only a small part of the anterior be removed. Interfering with the blood supply of the infundibular stalk by clamping and separating it caused degeneration of the cells of the pars anterior and intermedia, and lead to *dystrophia adiposogenitalis*, together with glycosuria and emaciation. The latter was also produced by artificial tumors in the sella turcica which interfered with the blood supply of the pars anterior.

The favorable influence of glandular feeding is still an exceptional experience with those who have had many cases under observation. The result in the case of de Schweinitz below mentioned is as brilliant as it is difficult to explain. Why such an extraordinary effect upon the pituitary lesion should be accomplished in 1 case and not in 99 others is a therapeutic myth. One almost ventures to attribute the results to some other factor, such as the rupture of a cyst or spontaneous sellar decompression. While as a routine practice all my patients with visual disturbances after operation, and a great many before, have been placed upon glandular

⁵⁰ Journal of Experimental Physiology, 1917, xi, 77.

feeding, I have no tangible evidence which could be used in support of its favorable influence upon pituitary lesions. The condition above all others in which, for biological reasons, glandular feeding should be effective is the pituitary dystrophies of the growing child. Here glandular deficiency seems to be the underlying factor, and not, as in most of the cases of a later period, such lesions as hyperplasia, adenomata or malignant growths. My experience leads me to believe there is a large field for the intelligent use of pituitary and thyroid extract in children who present many of the symptoms of the Fröhlich syndromes. It is important, however, to begin the treatment in the early stages of the disease—the opportunity to do good at that time is much greater, while in the late cases there will be many disappointments.

A patient under the care of de Schweinitz and How,⁵¹ a woman, aged fifty-one years, had throughout her life suffered much from neuralgia, headache particularly on the left side, and rheumatism. There was a history of convulsions in childhood, and recently a numbness of the hands and all the fingers and thumb of the left hand. For fifteen years she came from time to time to have her eyes examined and glasses changed, during which time no unusual condition was noticed until June, 1914. Headaches at this time were particularly severe, and vision in the right eye, which had previously been normal, became blurred. An examination showed O. D. 6/60, O. S. 6/9, and marked pallor of the optic disk, especially in the temporal half. An examination of the visual field showed moderate contraction and paracentral temporal scotomas; the *x*-rays revealed an enlarged sella turcica but no actual destruction of the walls and no encroachment on the sphenoidal sinus. The vision in the right eye improved, but in the left it deteriorated until in nine months it was reduced to 4/150. The right eye had never fallen below 6/60. The visual field defects progressed to a well-marked bitemporal hemianopsia.

The patient was placed on tablets of thyroid and pituitary body extract, two and one-half grains each, and from about July 1, 1914, to February 24, 1916, she had taken about 7000 grains. She was also given inunctions of mercury for a short time but the favorable results were attributed to the glandular feeding. The visual field was gradually restored, vision in the right eye was 6/5 and in the left 6/12, and the headaches and other symptoms had disappeared.

Elsberg and Krug⁵² employed glandular feeding in a case of hypopituitarism. The history of the patient was typical of glandular deficiency except for the eye changes which indicated a pressure on the chiasm or the left optic tract. Temporary improvement followed a decompressive craniotomy, but the symptoms of secretory deficiency and pressure on the optic tract reappeared. The *x*-rays showed a small sella turcica with normal clinoid processes. A diagnosis of dyspituitarism with glandular deficiency and cyst formation was made, and the treatment begun with daily hypodermic injections of pituitary extract. Within two days improvement was noticed, and one week later there was marked return of strength and much of the previous pallor of the disks

⁵¹ Arch. Ophth., 1917, xlv, 139.

⁵² Ibid., p. 97.

had disappeared. After this the injections were given once a week for two months, during which the visual field had become much enlarged and vision improved. After two more injections at an interval of one month, vision was O. D. 20/30, O. S. 20/40, and when seen again, ten months later, vision was excellent and the only complaint an occasional nosebleed.

The surgical aspects of pituitary disease are about as they were a year ago. There are but two accepted methods of approach, the transphenoidal and the transfrontal, each with their advantages and disadvantages. In a paper read at the 1917 meeting of the American Medical Association, I sketched the relative merits of the two methods and tried to make it clear that neither should be practised to the exclusion of the other. The crux of the problem of pituitary surgery is not the exposure of the sella contents, but the restrictions that are imposed upon the operator in dealing with them. The inability to deal radically with the lesions will of necessity affect the degree and the duration of the post-operative results.

In the transphenoidal approach, Segura,⁵³ in order to provide a more ample field, resects the free edge of the inferior or all of the middle turbinates eight to ten days before the final stage, and, as the last step in his operation he detaches the right septal mucous sheath from its posterior insertion. This enables a greater displacement and gives a wider exposure and avenue of approach. In his after-treatment he introduces an unusual practice by inserting a gauze tampon between the mucous flaps. He seems to feel that the formation of a clot in this space would interfere, as it might, with drainage, but for what purpose drainage is indicated is not clear to the writer.

Douglas,⁵⁴ in recording 2 cases of *multiple hemangiomas of the skin associated with dyspituitarism*, remarks that the association of these two conditions has not hitherto been mentioned. In one case the skin of the scrotum, the penis, the inside of the thighs, arms, back and abdomen were affected; in the other, the angiomas were scattered over the scrotum and the mucous membrane of the lips and the mouth.

In a case of tumor of the pituitary body, Tilley⁵⁵ did a Moure's lateral rhinotomy of the left side, with a submucous resection of the posterior third of the septum, removal of the anterior wall and septum of the sphenoidal sinus, followed by removal of the posterosuperior wall of the sinus and portion of the tumor. A tampon of gauze was inserted into the sinus and the external wound sutured. Great care was taken not to wound the easily visible lateral walls of the sinus. In spite of this, the right upper and lower eyelids were intensely discolored but not swollen the next day. The patient made a good recovery, and, seventeen days after the operation, was able to read without difficulty. The exact nature of the tumor was not indicated. The reason for reporting the case is to draw attention to the easy access to the sphenoidal sinus by means of Moure's lateral rhinotomy.

⁵³ *Semana méd.*, 1917, xxiv.

⁵⁴ *Archives of Internal Medicine*, 1917, xx, 24.

⁵⁵ *Proceedings of the Royal Society of Medicine*, 1917, x, laryngol. sect., 3.

TUMORS OF THE GASSERIAN GANGLION.

In the great majority of instances the term is a misnomer, since tumors so designated do not take their origin from the ganglion, and in but one instance did the tumor contain nerve elements. Inasmuch as the involvement of the ganglion is a mere coincidence, these tumors should be designated tumors of the middle fossa involving the Gasserian ganglion. Altogether, I have been able to find only 14 cases in which the tumor was exposed at operation and 3 of those occurred in my own clinic. But 2 of the 14, 1 which I reported⁵⁶ and one reported by Sachs⁵⁷ were of such a character that complete removal of the tumor was possible. The remainder were distinctly inoperable growths. In Sach's case the operation was performed ten months after the onset of the first symptom. The only way in which it differed from the usual technic was that more bone was removed than usual, and the middle meningeal artery was plugged with a wooden peg and cut as it passed through the foramen spinosum. The tumor was about the size of a cherry lying in a cavity of the floor of the skull about 1 cm. deep. It had apparently completely replaced the ganglion and was evidently extradural, since the dural sheath did not have to be opened. After the operation there was a transitory paralysis of the third and sixth nerves, motor aphasia and slight weakness of the right hand. These disappeared after the removal of pressure, but, in addition, Sachs discovered a twelfth nerve paralysis and a herpetic blister on the nasopharyngeal side of the soft palate on the left side. Six or seven weeks later the twelfth nerve paralysis had improved but had not altogether disappeared. Another unusual feature in the case was that after the third nerve paralysis disappeared, the pupil, previously dilated, became contracted. Electrocardiograms revealed no disturbance of the vagus, so that the twelfth nerve paralysis was thought to be of central origin. After the operation, the anesthesia was as complete as after avulsion of the sensory root of the ganglion. The patient left the hospital in two weeks entirely relieved of the pain, but returned in six or seven weeks with a recurrence. At the second operation the region was exposed through the previous incision and an inoperable tumor found. The patient died about seven months later in a state of great emaciation and totally blind in her left eye. At the autopsy, the Gasserian ganglion was found flattened out to the thinness of a sheet of paper. The opening in the dura through which the sensory root passes from the pons to the ganglion appeared entirely empty, but on careful microscopic examination a few flattened fibers were found on the upper and inner margin of the opening.

The tumor removed at the first operation appeared well-encapsulated, but, on section, one portion was found where the growth had evidently not been completely removed. It gave the impression at first of a carcinoma, but, after histological examination and comparing it with the tumors described by Marchand, Giana and Spiller, Sachs feels justified

⁵⁶ *Journal of the Nervous and Mental Diseases*, 1917, xlv, 440.

⁵⁷ *Annals of Surgery*, 1917, lxi, 157.

in calling it an endothelioma. It arose in a region where there was no epithelial tissue, and, from the intimate attachment of the tumor to the dura, it seemed fair to assume that it took its origin from this structure.

CRANIAL NERVES.

Trigeminal Nerve. According to Abbe,⁵⁸ the usual radical operation for *tic douloureux* is both difficult and dangerous except in the hands of the expert. To this statement no exception should be taken, but I would go a step further and include Abbe's operation. As a matter of fact all operations on the Gasserian ganglion or its sensory root should be practised only by those whose large experience justifies the undertaking. The mortality in my clinic is lower than that of any major operation, as a matter of fact there have been no fatalities in the past four years. Abbe proposes what he styles a simplified procedure which he has used several times in the past five years, following which there was no recurrence. His method consists of severing the nerve trunks, pressing back the dura as far as possible toward the median line and placing an aseptic sheet of lead about one by one and three-quarters inches, of the thickness of a sheet of writing paper, large enough to cover the foramina and leaving a wide margin on either side. Each end of the cut nerve is then pushed down as far as possible into the foramen and the latter plugged with very thin sterilized lead foil. The ganglion is then allowed to settle down, the lead plate being pressed down everywhere so as to make it conform to the irregular indentations of the skull. Abbe showed the *x*-rays of 4 cases with the lead in sight, one of five years' duration without a return of symptoms.

In a number of cases in which he had used gutta-percha plugs and sheets sandwiched beneath the ganglion over the foramina the symptoms had recurred, and at the second operation the regenerated nerve filament could be seen entering the foramina from the ganglion, one little thread in one instance, three fine white strong threads in another and a small bundle in a third instance. The sheets of gutta-percha had been displaced and allowed the neurons to build up a nerve around it. This is not possible when the lead plate is used. An interesting observation in the secondary operations was the reduction in the sizes of the foramina to one-half their normal dimensions.

I have previously referred to the problem of *alcoholic injections* of the ganglion and called attention to the large number of corneal ulcers which have resulted. The incidence is so large as to make it prohibitive as a substitute for the radical operation save in those cases, a very small number, where any operation is prohibitive. The technic is not easy to master, and, in addition to corneal complications, there have been reported a number of cases in which the function of the oculomotor and abducens has been arrested.

His experience with 3 cases has been reported by Vaughan.⁵⁹ In the first case, two injections at an interval of a week were required before relief was complete. A wide dilatation of the pupils lasting for two or

⁵⁸ Medical Record, 1917, xci, 915.

⁵⁹ Annals of Surgery, 1917, lxvi, 287.

three days followed the second injection. When examined one year later there was a congestion in both eyes but no corneal ulceration, and the entire distribution of both trigeminal nerves was free from pain but not from pressure-sense. In the second case only the right ganglion was injected. The pain disappeared, but there was some ptosis and dilatation of the pupil. In the third case the infra-orbital nerve had been removed ten years previously, with permanent relief, but there was pain in the regions supplied by the first and third divisions. One c.c. of 95 per cent. alcohol was injected, with immediate relief. The injection was too recent to judge of the permanent results.

The technic is as follows: With the patient in a half-reclining position under local anesthesia, with a cork between the teeth in order to lower the sigmoid notch about half an inch, the graduated needle with blunt point was inserted to the lower part of the malar bone and carried inward through the lower part of the sigmoid notch, slightly backward and slightly upward, until the point entered the foramen ovale, indicated by the limitation in the lateral motion of the point by depth— $4\frac{1}{2}$ cm.—and by the escape of a few drops of cerebrospinal fluid. The needle was pushed a little farther until the total distance from the skin was 5 cm. The syringe was then attached and 1 c.c. of novocain with adrenalin injected, and, after the conjunctival reflex was abolished, 1 c.c. of alcohol was injected and the needle withdrawn.

Facial Paralysis. Most operations for the relief of paralysis of the facial nerve have disregarded the seat of the lesion, usually in the petrous portion of the temporal bone, and an anastomosis effected after the nerve has made its exit from the stylomastoid foramen. A different course has been pursued in several cases of gunshot injuries involving the facial nerve, with complete paralysis. In 1 case, recorded by Brindel,⁶⁰ the patient, a soldier, was buried under a blockhouse and sustained a fracture of the base of the skull. When seen by Brindel, five weeks after the injury, paralysis of the left side of the face was complete. The auditory nerve escaped injury. The facial nerve was thought to be severed or compressed in its intrapetrous course near the seat of the fracture in the lower half of the external auditory canal. The reactions of degeneration were present but not complete. At the operation, sixty-one days after the injury, the line of fracture was discovered, together with a mastoiditis. The bony bridge, forming the posterior wall of the tympanomastoidean canal, had broken away, the vault had fallen and the loose fragments had severed the Fallopian canal. The fragments were carefully removed, great care being taken to avoid any fibers of the facial nerve which might still be intact in the canal. There was not the slightest sign of facial contractions during this maneuver. The tympanum and the ossicles, of course, had to be sacrificed. During the convalescence the electric examination showed almost complete reactions of degeneration; there was a slight return of faradic response in the levator of the upper lip and also of the nostril. Three months after the injury the function of the facial nerve was entirely restored and hearing improved.

⁶⁰ Journal de méd. de Bordeaux, 1917, lxxviii, 87.

Three operations for the relief of facial paralysis following gunshot wounds were reported by Moure.⁶¹ In the first, the bullet entered the right nostril and came out in the retromaxillary region, injuring the facial nerve at its exit from the stylomastoid foramen. Operation, performed three months after the injury, consisted in removing loose fragments of bone and granulation tissue. The results are not recorded. In the second case the facial nerve was injured in its intrapetrous course; the reactions of degeneration were complete. At the operation, ten months after the injury, it was found that the nerve had not been severed, but was the seat of a neuroma a little above its point of emergence from the stylomastoid foramen. The neuroma was removed and function returned in two months. In the third case, operated upon fifteen months after the injury, the facial nerve was found to be almost completely severed, only a fine filament being left. The divided ends were sutured and there was some return of function within five months.

Cranial Nerves IX to XII.—In the intracranial injuries of civil life the involvement of the last four cranial nerves is conspicuous by its absence; any one of the first eight cranial nerves more or less frequently, but the last four rarely. The reports of gunshot injuries of the head, with involvement of the last four cranial nerves, is extremely interesting. Already 14 cases have been recorded, 2 of which are described by Lannois Sargnon and Vernet.⁶² In one, a bullet was removed from the lateral aspect of the right atlas behind the vessels on the right side, and the right lateral sinus was tamponed; in the other, the bullet penetrated the right cheek and lodged in the right rectus capitis lateralis muscle. It was not removed. The symptoms in both instances were alike; they included hemiparalysis of the tongue with reactions of degeneration, hemiparalysis of the superior constrictor of the pharynx, laryngeal hemiplegia, acceleration of the pulse, hemiparalysis with atrophy and reactions of degeneration of the sternocleidomastoid and the trapezius, total anesthesia of the paralyzed portion of the velum and the pharynx, anesthesia of the auricular branch of the vagus on the corresponding side. There were also involvement of the sympathetic system, expressed in 1 case by a myosis without marked enophthalmos and vasomotor disturbances, and in the other by a mydriasis, slight exophthalmos without the characteristic vasomotor disturbances. Briefly, the syndrome included lesions of the following cranial nerves:

Paralysis of the ninth.	Taste disturbances and paralysis of the superior constrictors on the injured side.
Paralysis of the tenth.	Velopharyngeal hemianesthesia, and hemianesthesia at the level of the auricular branch, spasmodic cough and respiratory troubles, intense salivation.
Paralysis of the eleventh.	Internal branch: hemiparalysis of the velum of the larynx, acceleration of the pulse; external branch: hemiparalysis of the sternocleidomastoid and of the trapezius with reactions of degeneration.
Paralysis of the twelfth.	Hemiparalysis of the tongue with reactions of degeneration.

⁶¹ Journal de méd. de Bordeaux, 1915-16, xlv, 179.

⁶² Lyon méd., 1916, cxxv, 336.

HYDROCEPHALUS.

Schlapp and Gere⁶³ present their results of clinical, postmortem, and histological observations in 8 cases of internal hydrocephalus of the obstructive type with special reference to the occlusion of the aqueduct of Sylvius as a cause of ventricular disease. The cases, selected at random, all presented either complete occlusion of the aqueductus cerebri or obliteration of the fourth ventricle, due to pathological changes in the ependymal or subependymal tissues.

In addition to the congenital obstructive type under consideration, they distinguish an apparently idiopathic type which occurs in previously healthy young adults and older children. They believe that in these there has always existed a predisposing constitutional weakness and that excessive stimulation, by some local factor, of the ependymal cells has led to gliosis with consequent closure of the iter. Their general conclusions are that many, if not the majority of cases of the congenital form of hydrocephalus may be attributed to "closure of the aqueduct of Sylvius through proliferation of the glia and ependymal tissues, or to invasions of the fourth ventricle by tumors having their origin in the floor, the choroid plexus or the membranous roof of the ventricles." Not all the cases of the acquired types are due to meningitis, acute infections, bacterial invasion of the brain or to the extension of the infection from the middle ear or cells of the mastoid, frontal and ethmoid bones. Some of these are to be explained by a consideration of the life process of the cell.

"Metabolism is nowhere more delicately expressed than in the highly complex chemical reactions of the cells of the central nervous system; and while knowledge of these reactions is still far from complete, it is nevertheless conceivable that any slight noxious influence may be sufficient to seriously disturb the latent forces of the glia, resulting in the dominating influence of one or another of the processes residing in these cells. These life processes may be into the nutritive, the formative, and the functional activities. In the first, which involves an appropriation of nutritive substances from the blood, potential energy is stored up and is subsequently translated into formative or functional activity, as represented by cell division on the one hand or by functionation of the specialized cell on the other. In cells which have become highly specialized, as the nerve cell, gland cell, and muscle cell, the potential energy of the cell body is converted into the predominating activity, and the formative processes held in abeyance, and so long as the normal relation between synthesis and catalysis is maintained, functional activity of the cell remains in a state of constancy. On the other hand, those cells not highly specialized, as the ependymal, glia and the connective-tissue cells, formative activity is easily awakened, and so it happens that in many cases of hydrocephalus, stimulation of those cells by some irritating substance results in an active proliferative process which involves not only the ependyma but the subependymal tissues of the aqueduct of Sylvius, as seen in the oblitative gliosis."

⁶³ American Journal of Diseases of Children, 1917, xiii, 461.

The problem of hydrocephalus is ever with us, and has been discussed *in extenso* in previous numbers of PROGRESSIVE MEDICINE. The differentiation between the various types, the obstructive, non-absorptive and hypersecretory type should always be attempted before the selection of any surgical proceeding is contemplated. Up to the present time, with a few exceptions, the surgery of hydrocephalus implies only attempts at drainage, some reasonable, some bizarre. I shall refer to two articles on ventricular drainage, without comment save to say that strips of thin celloidin offer a better drainage material than either linen or silk.

We note a *preliminary report* on 41 cases of hydrocephalus, by Sharpe,⁶⁴ who drains the ventricles into the subcutaneous tissues of the scalp by means of linen strands. By the time the strands of linen become absorbed, the in-growth of endothelium along the course of the threads, according to the author, has formed a permanent channel. In the series of 41 cases there were 13 deaths, probably due to the rapid loss of cerebrospinal fluid, and of the 28 surviving cases only 6 seemed improved. The report, however, was too recent to judge of the ultimate effect of the operation.

Sharpe distinguishes between external and internal hydrocephalus by the following method: With the patient in a horizontal position and the midline of the head on a level with the spinal column, spinal puncture and ventricular puncture will show equal pressure in case of external hydrocephalus, while in the internal type the ventricular pressure is the greater.

Peskind⁶⁵ advocates drainage of the ventricles as early as the first or second month in congenital hydrocephalus. In one case he operated in the seventh month upon a child with other congenital defects—spina bifida, fracture of the femur and paraplegia. The spina bifida was repaired in the fourth week, and the child gained in weight until it was six months old, when it began to lose ground. The hydrocephalus, present at birth, became more pronounced, as it often does under these circumstances, and Peskind drained the ventricles by the following method: Under local anesthesia three half-inch incisions were made in the scalp and three holes $\frac{3}{16}$ in. in diameter trephined in the skull on the right side, the center hole over a supposedly silent area, one about two and one-half inches to the front and the other about one-half inch to the back. The dura in the center opening was then punctured and a long probe, with V-notch at one end, mounted with four strands of Pagenstetcher linen thread, was introduced into the distended ventricle. Another probe bent upward and perforated near its end was threaded with a loop and passed through the anterior opening between the bone, and when exposed at the middle opening, the ends of the four threads were threaded through the loop and drawn forward to be left buried between the dura and skull. The probe was then passed through the posterior opening beneath the dura until it reached the middle opening,

⁶⁴ American Journal of the Medical Sciences, 1917, cliii, 573.

⁶⁵ Cleveland Medical Journal, 1916, xv, 693.

where the remaining four threads were caught and drawn back between the dura and left in the subdural space. The skin incisions were closed with silkworm-gut sutures. A small amount of cerebrospinal fluid escaped during the operation and for about twenty hours subsequently. At the end of three weeks there was a marked improvement as to the size and shape of the head; the forehead was less bulging, the veins not so full, the eyebrows better defined, the skin of the forehead wrinkled, the eyelids were more mobile and the eyes a little less prominent. The threads were left *in situ* for twenty-seven days and then removed through the middle opening. The threads were perfectly clean and the cerebrospinal fluid withdrawn was normal. The threads had evidently caused neither infection nor irritation.

Drainage of the ventricles by callosal puncture should not be practised except as a matter of temporary expediency. My attention was called to the report of this operation by Halsted⁶⁶ as a means of treating hydrocephalus. I speak with a certain hesitancy on this question, but as a result of my opportunities for observation I am coming to the conviction, rather regretfully, that the callosal puncture opening does not remain patulous indefinitely but only for a limited time. This is unfortunate since the immediate effects are so satisfactory and the technic so simple.

RHINORRHEA.

The spontaneous flow of cerebrospinal fluid—rhinorrhea—has long been recognized as a possible accompaniment of brain tumors or chronic hydrocephalus, at all events of conditions with increased intracranial tension. The escape of cerebrospinal fluid, automatically, affords a relief of pressure which in its beneficent action exceeds by far the usual surgical procedures designed for the same purpose. As some one naïvely said, if the surgeon could but imitate nature's method of regulating intracranial pressure by the establishment of a cerebrospinal fistula, many of the problems of intracranial pressure would be solved. As a matter of fact, it is well-known that in transphenoidal operations upon the pituitary the escape of cerebrospinal fluid immediately after the operation is rather an ominous sign, as indicating a direct communication with the subarachnoid space and predisposing toward meningitis. Nature's technic in the establishment of a fistula differs in these respects; the fistulous tract in course of preparation, extending over many weeks or months, is gradually but thoroughly protected by adhesions from sources of infection.

Without an autopsy one can never be quite sure as to the diagnosis, that is, whether one is dealing with a tumor or chronic meningitis with hydrocephalus. I vividly recall the case of a child who undoubtedly had distended ventricles, an enlarged sella turcica, convolutional markings of the skull, signs of disturbances of both pineal and hypophyseal function, and so much ataxia that locomotion was utterly impossible. I had drained the ventricles by a callosal puncture for the purpose of relieving

⁶⁶ Surgical Clinic, Chicago, 1917, 1, 489.

the headache and vomiting, but more particularly the papillo-edema. When all hope of permanent recovery had been abandoned and the condition regarded as hopeless, a rhinorrhea made its appearance, and from that time the patient's condition has been restored almost to normal, at least insofar as she is now able to resume the activities of school life.

The case of Souques and Odier⁶⁷ has many points of interest. The flow began about nine years after the appearance of the first symptom, it was continuous day and night, increasing and decreasing at times, for no accountable reason, the quantity varying from 300 to 500 c.c. The examination of the fluid established its character. The x-ray examination showed the deformation of the sella turcica characteristic of an intrasellar lesion. The enlargement of the sella turcica and the obliteration of the sphenoidal sinus confirmed the diagnosis.

MENINGITIS.

Someone suggested the term pyocephalus for that residual condition of meningitis, when the outlet to the ventricles is obstructed and the purulent exudate so pent up that its pressure and toxic influence leads to disastrous results. In this connection, I emphasized the necessity of direct ventricular drainage and of intraventricular therapy with appropriate sera. The relapses which one sees in meningitis, even in the serum treatment of cerebrospinal meningitis, are unquestionably due to the extension of the infection to the ventricles themselves and to their isolation. As Ramond⁶⁸ puts it, cases of prolonged meningitis are due to an infectious ependymitis. Postmortem observations confirm his theory that infection of the cerebrospinal axis by meningococcus or other organisms takes place in two stages: the first stage involves the subarachnoid space, the second the ventricular cavities *via* the foramina of Magendie and Luschka. Ramond introduces certain experimental evidence to prove that there is not a free circulation between the ventricles and subarachnoid space in either direction. For example, methyl blue, injected by lumbar puncture, penetrates the ventricles with difficulty, and inversely, when introduced into the ventricles, it shows no disposition to enter the subarachnoid space. For this reason when the ventricles are involved the serum must be injected directly into them. Even though there may not be free communication in cases of meningitis between the ventricles and the subarachnoid space, there are, so Ramond maintains, microscopic avenues which permit the passage of microorganisms from the ventricles to the subarachnoid space, and *vice versa*. Therefore, if no attempt is made to arrest the disease by intraventricular treatment, the ventricles continue to act as a constant source of infection and the intraspinal use of specific sera is ineffective. The meningitis is continued by repeated reinfection from the ventricles.

Intraventricular serotherapy for isolated cerebrospinal meningitis or ventricular ependymitis is also advocated by Verbizier and Chauvel.⁶⁹

⁶⁷ Bull. et mém. Soc. méd. d. hôp. de Paris, 1917, xli, 752.

⁶⁸ Progrès. méd., 1916, xxxiii, 95.

⁶⁹ Bull. et mém. Soc. méd. d. hôp. de Paris, 1917, xxxiii, 595.

In one case previously reported, the patient recovered; in another, though there was transitory relief, the patient died on the third day after an intraventricular injection of antimeningococci serum. Death was due to the virulent character of the infection.

OXYCEPHALUS.

The condition of oxycephalus is one which has caused many speculations as to its etiology. As the precise etiology is still undetermined, the opportunity for repeated observations may be instructive. Bedell's⁷⁰ experience with 3 cases in one family is unique. The father of the children spent the last two years of his life in an insane asylum; he was a paretic but had no abnormality of the head. The Wassermann reaction of his spinal fluid was positive. The mother was dead; she was an alcoholic, had a divergent strabismus and an expression suggestive of acromegaly. The oldest child, an intelligent girl of eleven years, was practically normal except that her head was somewhat square in shape, with a definite ridge over the bregma, and her forehead low. The vision in both eyes was 20/30; the pupils reacted to light and accommodation and were irregularly quadrate. There was eight degrees of exophoria in the left eye and 16.5 degrees of exophthalmos in both eyes measured with a Hertel instrument.

The second child, a boy, aged eight years, was not normal at birth, though labor was uncomplicated. His head was of a peculiar shape, his palate arched and high, the nasal septum deviated to the right and the turbinates were large. His lower jaw protruded, the superficial veins of the neck were large, the postcervical glands palpable. His chest was long and narrow, and the angle of the ribs more marked than normal. Respiration was abdominal. There was no evidence of early rachitis; the child appeared dull and his expression that of a mental defect. His forehead was high, sloping upward to the vertex, with a bony ridge to the bregma. Vision, right 20/70, left 20/30; both pupils reacted to light and accommodation, but were irregularly round on account of a straight nasal margin. The disks were irregularly round with whitish nerve heads and the vessels in parts blurred by swelling of the nerve head plus three diopters. There was a bilateral exophthalmos, measuring, with the Hertel instrument, 20 degrees. Nystagmus and a tendency to divergence were both present.

The third case, a girl aged seven years, was a forceps delivery. A stupid expression, mouth-breathing, high palatal arch, nasal septum deviated, moderate pharyngitis with adenoids, palpable posterior cervical glands, were some of the physical stigmata observed, but there were no signs of rachitis. The forehead was high and conical, the superficial veins in the frontal region prominent, and there was a distinct bony ridge at the bregma. The pupils, slightly irregular, reacted to light and accommodation, the disks, of irregular outline, were pigmented, pale bluish white, and the bloodvessels of irregular caliber. The Hertel

⁷⁰ Journal of the American Medical Association, 1917, lxviii, 1979.

exophthalmometer registers 10 degrees on the right and 8.5 degrees on the left. There was a divergence of 30 degrees with short excursive rapid lateral nystagmus; the disk was elevated to plus 6 diopters. The head was known to have been normal at birth and up to the second year, but it was not possible to ascertain when the change took place. The Wassermann reaction was negative in all the cases.

The second of the 3 cases was operated upon, but died in a few hours. At the autopsy the following abnormal features were recorded: The frontal region was unusually prominent; the inner surface of the calvarium and base of the skull showed unusually well-marked depressions, separated by sharp ridges; the bones of the skull were much thicker than normal. The brain weighed 1380 gm., rather large for the age of the patient, both hemispheres were equal in length though elongated, the convolutions were flattened, the left hemisphere being somewhat smaller than the right. Both optic nerves were atrophied but there was no closure of the optic foramina nor were there any signs of meningitis or rachitis. These findings would rather coincide with those of observers who do not consider rachitis a necessary preëxisting factor. In Case 2 the disease may have been present at birth, although the swelling of the optic nerve would hardly support this contention. On the other hand, optic atrophy was advanced in Case 3, although the child's head was known to have been normal until she was past two years of age. These are points of interest in connection with the etiology. If, in the second case, the deformity of the head was present from birth and yet for eight years there was no choked disk, and if, in Case 3, optic nerve atrophy was already advanced, there must be some cause other than cranial deformation to account for the visual disturbances. Furthermore, the case that came to autopsy showed no narrowing of the optic foramina, nor changes about the nerve or in the meninges.

THE PAROTID GLAND.

Method for Incising Parotid Gland without Injury to Facial Nerve.—Many surgeons fear to make incisions in this region for fear of injuring the facial nerve distribution, and consequently the following method by Lilienthal⁷¹ is worth reproducing: "A description of the method follows, but modifications will doubtless occur to the surgeon according to the requirements of the case.

"A vertical skin-deep incision is made in front of the auricle, and just as close to it as possible. This incision is extended to the hollow behind the angle of the jaw and thence in a gentle curve forward as far as the projection of the anterior border of the masseter muscle. The flap of skin thus formed is reflected forward, revealing the greater part of the parotid gland with its overlying fat and fascia. Incisions, as many as appear necessary for drainage, may now be made through the parotid fascia into the gland itself, the lines radiating in a general way along the course of the pes anserinus. No incision, however, should cross the

⁷¹ American Journal of Surgery, 1917, xxxi, 101.

line of Stenson's duct, for fear of salivary fistula. Deeper collections of pus may be evacuated through this same cutaneous incision by puncturing through the fascia behind the ramus of the jaw and then enlarging the opening with the director and dressing forceps.

"The openings into the parotid may be packed or otherwise drained, the cutaneous flap not being replaced until healing is well advanced, when it may be held in position with adhesive strips. A glance at the figures will make the entire procedure clearer than my words. The resulting cicatrix is far less obvious than smaller ones made by drainage through the cheek."



FIG. 1.—S leads to the double dotted line representing the location of Stenson's duct. The white lines represent the nerve branches in diagrammatic manner. The heavy dark lines are the incisions in the parotid gland. The wound runs too far forward.

THE FACE AND NECK.

Gunshot Injuries of the Mandible.—Of not uncommon occurrence in the present war are those distressing wounds of the face and jaw bones which have attracted particular attention, not only on account of the disfigurement which they cause, but even more so from the difficulty that was at first encountered in dealing with them. This difficulty is the logical outcome of an attitude that regarded dentistry and surgery as two distinct and separate professions. So long as this theory was allowed to dominate practice, a man who had an extensive injury of the face and jaw bone had about as much chance for an ideal result as had the man with an open fracture of a limb in the days when the physician and the bone-setter could find no common ground upon which to meet. The bone-setter and the physician who refused to recognize

the surgeon are of the past, but the surgeon and the dentist in their relation to each other only too frequently perpetuate the agnosticism of those older practitioners. (Blair.)

There is a great deal of literature on this subject, but I will only refer to Blair,⁷² Martinier and Lemerle,⁷³ Bennett,⁷⁴ Kazanjian,⁷⁵ Kazanjian and Burrows,⁷⁶ Valadier and Whale,⁷⁷ Colyer,⁷⁸ Mummery,⁷⁹ and Cole.⁸⁰

In the British Army, soldiers suffering from wounds of the face and jaws are collected in centers for treatment. Some of the advantages have been:

"The nursing staff is more efficient as they become familiar with, and devote their entire attention to, the care of fractured jaws. The daily care and feeding have been organized to make easier the treatment of a large number of patients.

"The development of a mechanical laboratory has made it possible to apply at an early date the splints and appliances which are essential to successful treatment.

"The treatment of cases during a period of over eighteen months has given opportunity to maintain a comprehensive system of records from which deductions can be made on the complications, mortality, etc." (Kazanjian.)

In these injuries the jaw is, in some respects, the most important part affected, but we must remember that the missile is apt to comminute many bones of the face and to lacerate the eye, nose, ear, head and submaxillary and cervical regions. Admission to the special hospital usually occurs two or three days after injury, and the man is suffering from mental shock, toxic absorption from the wounds, the lack of nourishment from difficulties in mastication. Furthermore, certain complicating injuries to the head, chest, abdomen, fractures of the long bones, etc., must be considered.

Three indications for treatment stand out, control of the sepsis in the wound, control of secondary hemorrhage, and fixation of the fragments. The region of the wound is anesthetized by the infiltrative or conductive method with a 2 per cent. solution of novocaine. Foreign bodies, fragments of teeth, or roots and detached segments of bone are removed.

"At the beginning of the war, broken fragments of bone were removed too freely; many such, if left, would have thrown out callus. A tooth should never be removed if there is any chance of it subsequently forming a useful support for dentures or other appliances. Even in the line of fractures the extraction of a tooth may be left until later, since for the period immediately following injury it may provide an invaluable *point d'appui* for some appliance." (Valadier and Whale.)

Shreds of tissue, all unimportant lacerated and contused skin, muscle

⁷² 1917, C. V. Mosby Co., St. Louis.

⁷³ *Injuries of the Face and Jaw*, William Wood & Co., 1917.

⁷⁴ *Practitioner*, 1917, xcix, 210.

⁷⁵ *British Medical Journal*, 1917, ii, 3.

⁷⁶ *British Journal of Surgery*, 1917, v, 126.

⁷⁷ *Ibid.*, v, 151, and *British Medical Journal*, 1917, ii, 5.

⁷⁸ *British Medical Journal*, 1917, ii, 1.

⁷⁹ *Practitioner*, 1916, xcvi, 73.

⁸⁰ *Lancet*, 1917, i, 415.

and fascia tags are cut away. The mouth is irrigated at frequent intervals, day and night, with some antiseptic, such as boric acid or potassium permanganate, and the mucous surfaces swabbed clean with cotton pledgets soaked in tincture of iodine. Attention should be paid to food particles about the roots of teeth. In 463 cases Kazanjian had 2 fatal cases of septicemia, and 5 fatal cases of bronchopneumonia. Many cases had bronchopneumonia on admission, and he attributes it to the use of general anesthesia. A spreading cellulitis, erysipelatous in nature, was observed several times.

Valadier and Whale urge that the extensive wound in the face should be closed as soon as possible. They insert two rows of stitches - a deep layer of heavy catgut, embracing the facial and muscular strata and a superficial layer of silkworm gut approximating the skin. The parts need not be brought into perfect apposition at the start if there is much tension.

In the 1010 cases treated by Valadier and Whale there were 7 deaths from pneumonia; they also had erysipelas, sinusitis, quinsy and deaths from septicemia, septic meningitis, pyemia, and mediastinitis.

HEMORRHAGE. Among 400 cases treated by Kazanjian and his co-workers, there were 34 cases of secondary hemorrhage (8.5 per cent.), and, of these, 7 were fatal. The majority took place between the fourth and twelfth day, and, curiously, most of them appeared during the night or early afternoon. The following table indicates the source:

Hemorrhages from	No. of ligations.	Deaths.
Facial artery (or branches), 7	{ Under local anesthesia, 5	} 0
Nasal region, 4	{ Under general anesthesia, 2	
	
Lingual or inferior dental, 21	{ Lingual, 6	1
	{ External carotid, 9	2
	{ Common carotid, 4	3
Pharyngeal region, 3	1
Totals 35	26	7

In one case hemorrhage occurred from both the nasal and the pharyngeal regions.

I may insert here that Valadier and Whale, in 1010 cases, only had occasion to ligate the artery in 11 cases.

Sometimes the hemorrhage occurs suddenly; often there is a preliminary seepage of arterial blood (this sign has been noted in civil surgery by keen observers). At the preliminary examination of the patient the exact areas from which bleeding may be expected should be noted. A separate tray containing swabs, ribbon gauze, hemostats, sinus forceps, head mirror, dental head mirror, adrenalin, hydrogen peroxide, etc., should be kept specially ready for this emergency.

"As soon as the hemorrhage appears, the attending nurse should send for the medical officer, and, while awaiting his arrival, should syringe the patient's mouth with hydrogen peroxide, and attempt to control the bleeding with digital pressure. The patient should be kept sitting in bed against a back-rest, to facilitate the work, to reduce the blood-pressure in the head, and to prevent the flow of irrigating solutions and

blood into the throat. The use of hydrogen peroxide gives a clean field of operation in the shortest time, and acts to a slight degree as a hemostatic. Following this, the area is swabbed rapidly, and that part from which blood issues is packed tightly with gauze soaked in adrenalin chloride.

"As an adjunct to packing a specially devised clamp will be found useful. This consists of a heavy piece of wire, from eight to ten inches long, bent to a U-shape, with a 'finger' or pad of dental modeling composition or vulcanite rubber on each end. The clamp is adapted by bending it so that one end presses over the packing while the other presses externally at a corresponding point under the chin between the hyoid bone and the lingual aspect of the mandible. Ligatures or elastic bands about the arms of the clamp will give the desired amount of pressure. A clamp of similar pattern, but of reduced dimensions, serves for the arrest of hemorrhage from the facial artery, exactly as one would pinch it with the thumb on the cheek and the forefinger inside the mouth.

"It must be remembered that even though the act of packing may not be the final means of stopping the hemorrhage, nevertheless it must be carried out to control it for the moment, and to minimize the chances of recurrence before ligation is effected." (Kazanjian.)

Operative Treatment of Hemorrhage. If the above measures fail, the bleeding-point must be ligated: (1) Directly at the point of bleeding; (2) proximal to the bleeding; (3) by means of external carotid ligation. Kazanjian and Burrows note four groups of cases in which ligation of the bleeding-point is the correct practice. (a) Those in which the bleeding is external; (b) intrabuccal hemorrhage of small volume, from an artery of the frenum, one of the palatine arteries, or some other branch of the lingual, facial, or internal maxillary; (c) from the free portion of the tongue, the ranine artery being the offender; (d) from the floor of the mouth with a wide-open face.

In many cases such direct ligation is impracticable and they then ligate the bleeding artery at a point proximal to the injury.

It is necessary to locate the particular artery which is bleeding, and this may be the lingual, inferior dental, facial or the external carotid itself, with its tonsillar, pharyngeal and other branches. It is not always easy to do this, the splinters of the jaw frequently acting as missiles, thus destroying the help derived from following the bullet track; the swelling of the tongue and other soft tissues is also complicating. Broadly speaking, Kazanjian and Burrows state that "(a) bleeding from the floor of the mouth comes from one or both lingual arteries or their branches; (b) bleeding from between the fragments of a broken lower jaw arises from the inferior dental; (c) bleeding from the cheek or lip has its origin in a branch of the facial; and, lastly, (d) bleeding from the pharyngeal and tonsillar regions will call for ligation of the external carotid artery."

They do not follow the at first obvious method of ligating the external carotid artery; the operation is formidable and dangerous, and recurrent bleeding is apt to occur after establishment of the collateral circulation. Experience has shown that profuse recurrent hemorrhage from the floor

of the mouth nearly always arose from one or both lingual arteries or their branches.

The external carotid is ligated as a final resort, or where the bleeding occurs from the pharyngeal or tonsillar regions.

Ligation of the Lingual Artery. This artery arising from the external carotid passes upward on the middle constrictor of the pharynx. In its second portion it is covered by the digastric and stylohyoid muscles, and farther forward by the hyoglossus. The third portion passes up between the hyoglossus and genioglossus, and, on reaching the free part of the tongue, is continued on its under surface to the tip as the ranine artery. Kazanjian and Burrows ligate either in the first or second parts and, as few surgeons are familiar with this ligation, I will give their description verbatim.

"(a) *Ligation of the First Part of the Lingual.* With the patient supine his face inclined to the opposite side, and the neck extended over a sand-bag, an incision is made along the anterior border of the sternomastoid, the center of the incision being opposite the great cornu of the hyoid bone. The sternomastoid having been exposed, the deep cervical fascia is divided parallel with its anterior border. The carotid triangle is thus uncovered. Within this triangle are the external carotid artery and its branches. They are concealed, however, by areolar tissue, lymphatics and certain veins, of which the common facial and the lingual, with their tributaries, chiefly concern us. There may be a temptation to try to expose the lingual artery by retraction of these veins. Unless, however, the exposure is quite easily accomplished in this way it is better to divide and tie any veins that obscure our view. Time ought not to be wasted in attempting to preserve any vein which lies in the way of a clear and unembarrassed field. The external carotid artery is now exposed, with the superior thyroid, lingual and facial arteries successively arising from its anterior wall a short distance above the bifurcation. The landmarks that must now be identified clearly are: (1) The posterior end of the great cornu of the hyoid bone; (2) the posterior belly of the digastric, with the stylohyoid muscle; (3) the hypoglossal nerve. All these are rapidly recognized. The lingual artery is then traced upward and forward to where it passes deeply to the hyoglossus, stylohyoid and digastric muscles. Two ligatures are applied at this point and the artery is divided between them. The reason for tying the artery so far forward is to allow a sufficiently long stump between the proximal ligature and the external carotid artery.

"(b) *Ligation of the Second Part of the Lingual.* The patient is arranged on the table in the same posture as for ligation of the first part. A curved incision is made, commencing half an inch below the mental tubercle, passing downward and backward to the hyoid bone or the upper border of the thyroid cartilage—according to the amount of displacement of the jaw—and then upward and backward to the sternomastoid muscle. The flap thus formed is turned up and the deep fascia is divided in the line of the original incision. The submaxillary gland is retracted upward so as to expose the floor of the submaxillary triangle and the following

landmarks are identified: (1) The anterior and posterior bellies of the digastric, with their intervening tendon; and (2) the hypoglossal nerve, lying on the hyoglossus muscle and crossing the angular space between the two bellies of the digastric to pass under the mylohyoid muscle. The hyoglossus is then cut through midway between the hypoglossal nerve and the greater cornu of the hyoid bone, the line of incision being parallel to the latter structure. This will expose the lingual artery, which is then tied in two places, and cut through between the ligatures.

"SPECIAL DIFFICULTIES. The displacement of the broken jaw and the swelling of the neighboring structures lessens the freedom and ease of exposing the lingual artery in many cases, nor is one helped very much by attempting to raise the lower jaw. In particular, the submaxillary salivary gland and the lymphatic glands in the submaxillary triangle are apt to form a solid, unyielding mass which lies in the way of a good view of the lingual artery. In some such cases retraction of these structures is unavailing, and it will then be found of great assistance to resect them: a maneuver which does not materially lengthen the operation, while it greatly facilitates exposure of the lingual artery in the second portion. We have had to carry out this detail in two instances.

"Another trouble is the depth at which the artery lies. This can be countered by the assistant, who, with his hand placed on the other side of the patient's neck, presses the hyoid bone up into the wound.

"On one occasion the second portion of the lingual artery could not be seen after the hyoglossus had been divided. The first portion was therefore sought, and it was found that the lingual arose from the external carotid at a higher level than usual, forming a common trunk with the facial. In this position it was easily identified and secured."

FIXATION OF THE FRAGMENTS. It is impossible for me to accurately describe the various mechanical supports used in the treatment of these jaw injuries. The results attained by the surgeon working alone bear no comparison to those attained where the surgeon and dentist work together. An expert dental surgeon is familiar with the various prosthetic apparatus and it is not necessary for the surgeon to do more than assist at their employment. All of the articles listed in the beginning of this section contain illustrations of the common and popular dental splints.

Fractures of the mandible in war time are accompanied by considerable loss of bone. For purposes of description they are roughly divided into two types:

Type I. Loss in the anterior part of the mandible, between the symphysis and the first molar.

Type II. Loss in the posterior part of the mandible, between the first molar and the condyle. (Mummery.)

The fragments should be replaced and fixed at the earliest possible moment. Pain is lessened, chances of hemorrhage are lessened, sepsis is reduced, and the ultimate result is more perfect. Mummery⁸¹ quotes Claude Martin as stating that the objects of treatment are two:

⁸¹ Practitioner, 1916, xcvi, 73.

1. To reëstablish the physiological functions of the jaws.

2. To restore the normal outlines of the face.

These objects are attained almost entirely by the use of splints—*traitement non sanglant*—and surgical intervention is only occasionally needed for the initial sewing up of the soft parts, and for skin grafting when there is much loss of soft tissues.

The treatment is divided into three distinct stages:

(a) Correction of displacement and fixation of the bony fragments.

(b) Reduction of cicatricial contraction and remoulding of the facial contours.

(c) Fitting of a permanent prosthetic appliance to replace lost parts and restore function.

A fuller description of Martin's work is given in the translated book of Martinier et Lemerle.

Bennett⁸² classifies these fractures into a first group consisting in "those cases in which the anterior portion of the mandible with the teeth contained therein as far back as the premolars, or even the molars, is destroyed. There is then an immediate inward displacement of the lateral halves, which rapidly becomes more pronounced. Some of the worst cases of false union, due to delayed or improper treatment, have occurred in this class; the mouth becomes parrot-shaped, occlusion of the teeth with the maxillary teeth is destroyed, mastication is impossible, and even speech is impaired; cicatricial contraction of the oral orifice is a frequent concomitant.

"The second group includes cases of fracture in the premolar or molar region anterior to the masseter. Sometimes this is double; more often single, and associated with damage to the maxillary teeth on the opposite side, when the path of the bullet has not been quite horizontal. In the case of double fracture, the center fragment is usually depressed, and the lateral fragments are drawn upward and inward. When the loss of bone on each side is considerable, the small anterior fragment is often displaced backward as well. In the case of a single fracture, the smaller fragment is drawn upward and inward, and the larger fragment is deflected considerably toward the injured side as well as drawn downward. It should be noted that the overriding or semi-impaction, that sometimes occurs in fractures caused by a blow, does not usually occur in war injuries, on account of the destruction and comminution of bone at the site of fracture.

"The third group consists of fractures at the angle, or of the ascending ramus, or coronoid process, or even of the neck of the condyle. An injury destroying the condyle itself is so high up as to probably kill its victim. This does not necessarily happen, however.

"Fracture at the angle is common, and is often associated, when caused by a bullet passing in an oblique direction, with fracture in the premolar region of the opposite side. Usually there is not much displacement in fractures of the angle or ascending ramus, on account of the parts being embedded in muscle tissue. In the early stages, infiltration of the soft

⁸² Practitioner, 1917, xcix, 201.

parts will often cause displacement to the opposite side; when this has resolved, displacement toward the injured side will develop, but even then opening the mouth often causes the mandible to deviate *from* the the injured side.

“In some cases of double or triple fracture, the jaw is so severely comminuted that the various parts are quite loose. Reduction is easy, and if the parts are attached to a simple appliance, good results may yet be obtained.”

In discussing treatment, Bennett states that when the fracture is behind the anterior border of the masseter there is usually no lateral displacement, and it is usually sufficient—in the early stages—to keep the mandible closed in normal occlusion by bandaging or by a mechanical apparatus.

In fractures anterior to the masseter, reduction and immobilization usually involve the use of complicated prosthetic appliances. These I will not describe.

The opportunities for the surgeon are best shown in the marvelous results obtained by plastic methods. All of the medical journals have contained frequent illustrations of these results, because they are so striking and so thrilling to the average reader. In the slighter cases, careful suture of the wound suffices, but, when the destruction of skin and other tissue has been great, it is necessary to obtain skin from elsewhere to fill the gaps and these flaps are usually taken from the neck or from the chest. The following from an editorial in the *Lancet*⁸³ is based upon papers by Gillies and Cole in the same number: “The flaps may be transferred by sliding, or transposed by the aid of a pedicle. When the mucous membrane of the mouth is intact, a simple flap of skin is quite sufficient to give good cosmetic results, but when, as occurs in so many cases, more or less of the mucous membrane has been lost, it will be essential that a double flap should be employed, one flap being placed with its epithelial surface directed toward the mouth, so as to take the place of the lost mucous membrane, while the other flap is so applied that its epithelial surface is directed outward. In some cases the raw surfaces of the two flaps are placed together at the same operation, while in others it may be advisable to insert the deeper flap at one operation, while the more superficial piece of skin is not applied until a later date. In both the articles published this week, examples of the procedure in question are figured. The great need for the insertion of a flap of skin to replace lost mucous membrane depends on the fact that it is not sufficient to have a good cosmetic result, but it is essential that the functional result shall be perfect, for the operation has been useless if the jaws are held together immovable by a dense mass of cicatricial tissue, such as would follow healing after a great loss of the substance of the cheek were no new tissue interposed. Function in all cases is of more importance than appearance, though nearly always, if due attention be paid to function, the cosmetic result can be made satisfactory by ingenuity, patience, and the intelligent coöperation of the surgical with

⁸³ *Lancet*, 1917, i, 420.

the dental expert. Sometimes one plastic operation will suffice; but, as a rule, more than one operation is needed, and not rarely many are required to obtain the best results. When, in addition to the damage to the soft parts, the upper or the lower jaw has been injured, the task of the surgeon becomes more difficult still, and in all but the slightest cases he must, in order to attain success, have recourse to the assistance of a dentist. Should there be nothing more than a simple fracture of the jaw, it may suffice to keep in position the parts of the broken bone; but nearly always there has been real loss of substance, and it is, moreover, rare for the fractures not to be compound, and comminution is almost the rule. In circumstances like these some mechanical support is necessary, and this must be provided by the dental expert. Such a support should be applied early, before any elaborate operation is undertaken to close the rent in the lips or cheek, for if it be postponed until some time after the operation is done, already no small degree of contraction will have taken place and the result will not be satisfactory. This point is emphasized by both Captain Gillies and Mr. Cole. The planning and fixing of the mechanical support are of the greatest importance and need meticulous care, but the results are commensurate with the care taken, and they are often almost miraculous. There seems to be no well-defined limit to what may be done, given the requisite time, and cases which to the uninitiated appear to be absolutely hopeless, may, after the fitting of dentures or other prosthetic appliances, and after one or many operations, show but few and inconspicuous signs of the harm wrought by the projectile. There is one point in the plastic treatment of these extensive injuries to which sufficient attention is not always given, and that is the preservation of the buccal sulcus, for if care be not taken to see that the buccal sulcus is preserved, it becomes exceedingly difficult, if not impossible, to fit a denture to that side of the mouth, and functionally so far the operation has failed, for that side of the mouth cannot be used."

Cole⁸⁴ classifies the various types as follows:

"Single Flaps. (1) Sliding. (2) Transposed, the type commonly used to remedy ectropion. These two forms can only be used when the tissues in the immediate neighborhood of the gap are sufficiently lax to admit of direct borrowing. (3) Transferred, depending temporarily for blood supply on a pedicle situated at a distance. (4) Hinged. A flap rotated on a hinged pedicle formed at the margin of the gap.

"Doubly Epithelialized Flaps. (1) Formed in the gap coincident with its closure by the interposition of a single flap with the immediate or later imposition thereon of a second single flap. (2) Formed at a distance, formation antedating closure, (a) with one primary pedicle, (b) with two primary pedicles.

"The use of single flaps is practically confined to reparative work on the lips. For this purpose the sliding and transposed flaps only can be utilized. The mucous membrane on the deep surface is included in the flap."

⁸⁴ *Lancet*, 1917, i, 415.

BONE-GRAFTING. When there is great loss of bone, it is not possible to produce a useful mandible, unless the bone is replaced by some rigid structure, either a permanent prosthetic apparatus or a new bony bridge. It is not necessary to go into this in detail because the subject has been made familiar to us all by the writings of Albee, McWilliams, and others. Indeed, McWilliams⁸⁵ has published a paper on the defects of the lower jaw in which he gives the following description of technic. I shall pass over the part descriptive of the management of the case where there is a sinus discharging under the lower jaw. It suffices to say that the sinus must be enlarged, sequestra removed, and the bone curetted. The teeth should be wired together by a dental splint. After the sinuses have nearly healed, the surgeon should consider the best means of filling in the defect. Operation is preceded a few days by fitting to the upper and lower teeth Angle's gold or German silver fracture bands with loops on the buccal surfaces.

"At the operation an incision is made along the lower outer border of the jaw, the point of non-union is exposed, cicatricial tissue is divided, opening into the mouth as little as possible, although this is almost unavoidable. The fragments are forcibly separated by some instrument which can be gradually opened, a most efficient apparatus being a mouth gag which is provided with two movable mouth jaws which are opened by a screw (pulmotor outfit). After the fragments are sufficiently separated, bronze wires are fastened between the upper and lower loops of the fracture bands, thus permanently maintaining the width of the defect. The mouth will most certainly have been opened by this procedure, rendering grafting at this time futile because of the resultant infection. The wound is sewn up without drainage and allowed to solidly heal for several weeks before attempting any graft procedure, the defect between the fragments being carefully maintained during this time by rigid, frequent inspection of the wires, which are apt to become loose."

At the second operation, the old scar is cautiously opened from below, exposing the lower borders of the two fragments. "Working from below upward, the vertical margins of the fragments are bluntly freed for a short distance, avoiding the tissues on the posterior or inner surfaces, and the edges of the bone are freshened with the rongeur. A portion of the outer surfaces of the fragments is laid bare with the periosteal elevator, care being taken not to open into the mouth. The vertical edges of the fragments having been freshened and the outer surfaces laid bare, transverse grooves are cut in the outer surfaces of the two fragments for at least an inch long with either a chisel or the twin motor saws. Two holes on each fragment are drilled from the sides, running into the grooves. Kangaroo-tendon sutures are then threaded through these holes. A corresponding sized graft with the covering periosteum, the latter taken larger than the bone transplant itself, is cut out of the tibia with the marrow also. No hand touches this graft at any time. The graft is placed in the grooves prepared in the lower jaw under the kangaroo sutures which are then tied with instruments over the trans-

⁸⁵ *Annals of Surgery*, 1917, lxx, 273.

plant, securely holding the graft in place. I formerly used metal sutures but have now substituted for them kangaroo tendon or chromic gut, since these have less tendency to invite suppuration than non-absorbable sutures. The wound is then closed by suturing the deep tissues securely over the graft and in contact with it and over this the skin is sutured separately. Before the anesthesia is completed, care should be taken to see that the wiring of the teeth is securely and accurately maintained. A dressing is applied to the wound, and between the dressing and the mouth a sheet of rubber tissue is glued with ether to the skin to exclude the possibility of dribbling from the mouth reaching the wound. The after-treatment consists in careful, frequent watching of the wires between the teeth to see that they do not become loose or broken. There must be no mobility whatsoever between the fragments for three months, for movement is fatal to grafts. In my experience the wires will have to be readjusted, tightened or replaced on an average of every two weeks. The patient is fed soft diet through any existing cavities in the teeth, or liquid diet may be administered. Feeding has not furnished any difficulties in any of my cases and none of the patients have complained of this." (McWilliams.)

Emphasis must be laid on the importance of care in working the fragments loose because, should the mouth be opened into, no grafting should be attempted, but the wound again allowed to solidly heal when another grafting may be attempted. McWilliams practises the most scrupulous Lane technic, and he does not agree with Albee that the bone graft is resistant to infection. Owing to the poor resistance of bony tissue, he intends in the future to follow the suggestions of Morestin and use costal cartilage instead of bone.

LIGATION OF THE COMMON CAROTID ARTERY FOR SECONDARY HEMORRHAGE. In an interesting paper, Bartlett and McKittrick⁸⁶ first discuss the literature on this subject. They show that, in 1795, Abernethy tied the common carotid for hemorrhage, but without success. In 1868 Pilz collected 600 cases of ligation of the common carotid artery. It was also shown about this time that about 25 per cent. of single ligations developed cerebral symptoms, but in *PROGRESSIVE MEDICINE* for March, 1916, I showed from the literature that neither the mortality nor the occurrence of hemiplegia was as great as commonly supposed. Bartlett and McKittrick then reviewed the first 105 cases which confronted them in the literature. Seven of these ligations were made in the treatment of spontaneous hemorrhage into the nose, nasal pharynx and mouth, and 15 were made for the control of hemorrhage secondary to operations, etc., involving injury to one of the branches of the common carotid artery. They express surprise that only 15 per cent. of the ligations were done for secondary hemorrhage but find that it "coincides fairly well with our clinical observations; for we know of a rather large number of patients (some of them our own) who have succumbed to recurring spontaneous or secondary hemorrhage without any attempt being made to relieve the condition by ligation of the common carotid.

⁸⁶ *Annals of Surgery*, 1917, lxx, 715.

This statement becomes all the more impressive in view of the fact that 10 of the 15 patients studied made a complete recovery after ligation of this artery in the treatment of repeated secondary hemorrhage from its branches. It will be seen that the mortality attending this treatment of secondary hemorrhage, with its otherwise practical certainty of a speedy fatality, is no greater than the general mortality of about 33 per cent. which has followed the ligation of this large vessel in many hundreds of instances in the treatment of the greatest varieties of pathological conditions. We are forced to the final conclusion that secondary and spontaneous hemorrhages from the branches of the common carotid are very frequent, and still ligation of this vessel, which saved two-thirds of the patients involved, was performed for this indication in but 15.25 per cent. of the cases analyzed. Must we not then ask ourselves in all seriousness, why modern surgery has *not* furnished this 66 per cent. chance to those sufferers who practically all die, under circumstances of a particularly distressing nature, unless this simple operation be performed?"

LIGATION OF THE INNOMINATE ARTERY FOR HEMORRHAGE. Alexander⁸⁷ reports a case of gunshot wound of the carotid artery in which, in order to control the hemorrhage, hemostatic forceps were thrust at random into the wound. Later, it was found that the innominate and carotid had been clamped. The bullet had partially severed the carotid at its junction with the innominate. The patient was greatly shocked but gradually recovered, and one week later, and at subsequent times, attempts were made to remove the clamps. Such attempts were always followed by hemorrhage. The patient died eighteen days after the time of injury, and from recurrent hemorrhages, but there seemed to be no difficulties experienced at any time from the ligation of the innominate.

Alexander finds from a review of the literature that there have been 36 cases of ligation of the innominate alone, with 30 deaths; 16 cases of simultaneous ligation of the innominate and carotid, with 6 deaths; 2 cases of simultaneous ligation of the innominate, carotid, and vertebral vessels, with 2 deaths.

EXCISION OF THE RETROPHARYNGEAL GLAND. Occasionally, suppuration in the retropharyngeal space produced a grave clinical condition. The infection occurs in the retropharyngeal lymphatic nodes, and may be acute and suppurative, or chronic and tuberculous. Usually, one opens the abscess through the mouth. Patterson⁸⁸ believes that, in addition to incision and drainage, the diseased lymph gland should be removed, if possible.

"An incision is made along the posterior border of the sternomastoid. It starts behind the tip of the mastoid process and extends downward for three inches or more. The deep fascia along the posterior edge of the muscle is divided. It is now possible to work inward toward the pharynx between the sternomastoid on the one hand and the splenius capitis and levator anguli scapulæ on the other. The dissection is now carried farther inward by separating the carotid sheath and its contents

⁸⁷ *Annals of Surgery*, 1917, lxxv, 115.

⁸⁸ *Lancet*, 1917, i, 487.

from their posterior relations. Any enlarged glands met with should be removed. In the neighborhood of the pharynx there may be some venous hemorrhage. Great help can be obtained in the exposure of the gland by using a strong retractor. Without employing an undue amount of force, the sternomastoid, carotid sheath, and even the larynx and pharynx can be pulled forward. One of the risks is perforation of the mucous membrane. In order to avoid this, the finger of an assistant in the pharynx is of great service. During the removal of this gland get the assistant to push it downward and outward toward the wound. By counter-palpation and the use of a blunt dissector, the capsule is defined. Undue force must be avoided, as the gland may contain an abscess. By keeping close to the gland capsule and working in conjunction with the assistant, there should be no real danger of perforating the mucous membrane. After removal of the gland, the skin is united by interrupted sutures. A small gauze drain should be inserted, otherwise blood may be extravasated into the cavity.

"A different class of case is that in which a tubercular retropharyngeal gland has broken down, with resulting infection of the surrounding tissues. A large abscess cavity may be present, causing a marked swelling in the pharynx and possibly in the neck.

"In such a case the abscess is first of all evacuated through the neck, or the sac of the abscess may, in exceptional circumstances, be removed, with its contents entire. Once the abscess cavity is incised, the opening should be enlarged. The walls of the cavity are inspected and the gland, which is probably present and in a caseous condition, is removed. The abscess wall should now be carefully curetted, or it may even be possible to excise it. Packing will generally be required. The rate of healing will depend on the thoroughness with which the disease has been dealt with. If the abscess is a very extensive one, as in the case referred to above, repeated aspiration from the outside, either with or without a modified dissection, would probably be the best mode of treatment, coupled with fixation of the head and treatment on general lines."

Tuberculous Cervical Lymph Nodes. In 1915 a very interesting study on tuberculosis of the lymph nodes was published by Harbitz, and recently he⁸⁹ has written what may be considered as a continuation. He says:

"In general, one may say that in children most of the tuberculous infections have their point of departure in tuberculosis of the lymph nodes; the tubercle bacilli are deposited here after they have passed through mucous membranes or the skin; here they proliferate enormously or remain latent, but virulent, for a long time, years and years, eventually escaping and infecting other organs. Most frequently the dissemination occurs by the lymph vessels, but also by the bloodvessels, and probably more often than now believed." Harbitz states that in the lymph-node tuberculosis of children, in one-half death results from pulmonary tuberculosis, in one-quarter from intestinal tuberculosis, and in the remaining fourth from miliary tuberculosis or tuberculous meningitis.

⁸⁹ Journal of Infectious Diseases, 1917, xxi, 196.

In his necropsy statistics of adult deaths, in 18 per cent. the anatomical picture clearly indicated tuberculous infection in childhood. This study emphasizes the importance of the proper hygienic care and feeding of the child. The importance of the milk supply is indicated by the findings of Griffith⁹⁰ who, in a study of 52 cases of cervical gland tuberculosis, found that in 72.1 per cent. the bovine tubercle bacillus was resident. After ten years of age the bovine organisms was only found in about a third of the cases; after twenty years in rather less than a fifth. The studies of Harbitz seem to me to show the vital importance of excision of infected cervical glands when they can be detected. We may not be able to reach the bronchial or mesenteric glands but the cervical group are certainly accessible.

If tuberculosis is progressive despite operation, we would expect that old scars in the neck would be found with reasonable frequency in a large series of patients who are suffering from clinical tuberculosis. Wang⁹¹ answers this question. During a period of one and one-half years at the Sea View Hospital, Staten Island, N. Y., 2000 patients with clinical tuberculosis were examined for scars on the neck. There were found only 64 scars (3.2 per cent.):

The scars of 20 occurred in childhood, their clinical tuberculosis not becoming evident to them until after childhood: Fifteen were improving, 5 retrograding; 12 had pulmonary tuberculosis, 4 pulmonary and orthopedic tuberculosis, and 4 orthopedic tuberculosis.

There were 18 whose scars appeared after childhood and before the onset of their clinical tuberculosis: Nine were improving, 9 retrograding; 16 had pulmonary tuberculosis, and 2 pulmonary and orthopedic tuberculosis.

There were 9 whose scars occurred after the onset of their clinical tuberculosis: Five were improving, 4 were retrograding; 7 had pulmonary tuberculosis, and 2 pulmonary and orthopedic tuberculosis. This group impressed one as having the poorest prognosis.

There were 17 whose scars occurred at the same time at which their clinical tuberculosis began: Fifteen were improving, 2 were retrograding; 13 had pulmonary tuberculosis, 1 pulmonary and orthopedic tuberculosis, and 3 orthopedic tuberculosis. This group seemed to have less active tuberculosis and a better prognosis than any of the other groups. It was rather difficult to classify some of these as to their type, and some had cases probably of uncomplicated glandular tuberculosis.

In discussing the first group, *viz.*, the 20 (1 per cent. of the total), in which the scar dated from childhood, Wang takes exception to the theory of childhood infection and says there is a growing belief among many observers that simple glandular tuberculosis in childhood adds resistance to later tubercular infection, and that few adults who show this die of tuberculosis.

A recent advocate of operative interference is Ladd⁹² who has operated

⁹⁰ Lancet, 1917, excii, 216.

⁹¹ Journal of the American Medical Association, 1917, lxxviii, 1963.

⁹² Surgery, Gynecology and Obstetrics, 1917, xxiv, 467.

on 159 cases in five years at the Children's Hospital, Boston. His results are as follows:

27 cases "lost" or recently operated on.

132 cases traced. One operative death. One death six months later from lobar pneumonia.

119 cases with excision of all palpable glands and portal of entry.

111 (93 per cent.) of these have no palpable glands or evidence of tuberculosis at examination made from one to five years after operation.

8 cases with palpable glands. Three of these appeared on opposite side. Two coincident with other tuberculous lesions. Two recurrences attributed to failure to remove portal of entry (tonsil). One apparent but very small gland with possible pulmonary lesion.

11 cases of tuberculous abscess. Treated by curetting, wiping and use of tincture of iodine. Five of these are cured. Six have active tuberculosis present—all need reoperating.

To sum up—116 of 130 cases, or 89 per cent., were cured by operative means, and cured within a few weeks. In 95, or 73 per cent., the wound healed by first intention and in the majority of the remainder the wound was healed inside of three weeks. "Though in this series of cases but 11 results from the incision operation have been presented, 41 of the dissection cases had had one or more palliative operations before being referred to me for excision. These cases have given ample opportunity for observation of the conditions following palliative operations, and have clearly demonstrated the undesirability of postponing surgical intervention until abscess drainage becomes a necessary preparation for an excision operation.

"In 34 patients having persistent sinuses coming for radical operation, the duration of the unsuccessful treatment varied from one month to more than four years. In 2, the sinuses had persisted for thirteen and twelve months respectively, in spite of tuberculin and hygienic treatment. In 3, the sinuses persisted for thirteen, eleven, and six months, in spite of tuberculin and x-ray treatment in the first, and x-ray treatment alone in the other two. The other 29 cases had had one or more incisions and some of them had excellent outdoor hygienic treatment as well. The average duration of the sinuses in those 34 cases was ten and one-half months before the operation for removal of the glands was performed. How much longer the sinuses would have persisted without the more radical operation being performed, of course, it is impossible to say. Likewise, it is difficult to tell how many of these patients would have eventually recovered, or in how many the disease would have gone to other parts of the body. Probably many of them would have eventually recovered but only after a long and tiresome siege of frequent dressings."

Ladd removes the tonsils and adenoids at the end of the dissection in the neck if the patient's condition warrants it. If not, this is done two weeks or so later. He does not believe that removal of the tonsils at the same sitting as the glands of the neck prevents primary union of the wound. He follows the method of Dowd in operating.

Hodgkin's Disease. Discussion of the causation of this disease continues. Yates and Bunting⁹³ state that they cannot offer final proof of the etiological relationship of *B. hodgkini*. Simmons and Benet,⁹⁴ in their report of 31 cases, state that the diphtheroid bacillus was found in 2 out of the 3 cases in which it was sought. Holding and Brown⁹⁵ believe the lesions are those of an infectious granulomata. They evidently agree with Torrey⁹⁶ that there is no specific diphtheroid organism in Hodgkin's disease. Cunningham⁹⁷ finds "diphtheroids" in the glands but finds they are similar, if not identical, with those found in tuberculous glands. He believes that such organisms have their natural habitat in the laboratory. He does not believe that the organism heretofore described by various other workers bears any relation to the cause of Hodgkin's disease. The latest "discovery" is recorded by Diaz, of Brazil.⁹⁸ He announces that the causal agent of Hodgkin's disease is a polymorphous fungus, and gives the germ the provisional name of *Adenomyces cruzi*. He suggests the name "adenomycosis" for Hodgkin's disease. Bunting and Yates lay great stress to removal of the portal of entry (inflamed tonsils, teeth, patches of dermatitis, etc.) and, while acknowledging the importance of such, Holding and Brown state that tonsillitis or other pathological conditions of the tonsils did not appear to be a frequent factor of the disease in their cases. They did notice that pruritus was an important early symptom and urge that persistent pruritus, especially of the extremities, aggravated by perspiration, should indicate the possibility of Hodgkin's disease. Bunting and Yates speak of "careful physical examination of patients complaining of nothing more serious than a lack of energy." Routine blood counting and accurate interpretations of tuberculin tests should follow, and a fortuitous early diagnosis may be made.

TREATMENT. As a result of the uniformly poor results obtained by all previous attempts at treatment, the evidently low degree of virulence of the infection, and the nearly identical problem presented by malignant disease, Bunting and Yates devised a composite sequential series of treatments by the following methods:

"1. To determine and to eliminate the portal or portals of entry of the infection, those chronic lesions of skin or mucous membrane pointed out by Trousseau, in 1865, and, curiously, never rediscovered, never even given any practical recognition by therapeutists.

"2. To extirpate so thoroughly all eradicable involved tissue in suitable cases as (a) to place the balance of power decidedly on the side of the individual instead of on that of the disease; (b) to eliminate this source of infection and intoxication, and (c) to prevent subsequent physical and physiological debility through the continued growth of this tissue *in situ* and consequent pressure and irritation on surrounding structures.

⁹³ Journal of the American Medical Association, 1917, lxviii, 747.

⁹⁴ Boston Medical and Surgical Journal, 1917, clxxvii, 819.

⁹⁵ Journal of the American Medical Association, 1917, lxviii, 701.

⁹⁶ Journal of Medical Research, 1916, xxxiv, 65.

⁹⁷ American Journal of the Medical Sciences, 1917, cliii, 406.

⁹⁸ Abstract in Journal of the American Medical Association, 1917, lxix, 1658.

"3. To keep the balance of power on the side of the patient (a) by improving general health through hygienic measures; (b) to prevent, by radiation, by immune serum, and by medication, any extension of the disease, and (c) to repeat these treatments at intervals of a few months, unless other manifestations of progress of the disease, as determined by the patient's condition and especially by untoward changes in the blood picture, demand more frequent treatments or more radical interventions."

Many writers, and especially pathologists and medical men, hold that surgery is of doubtful value, often harmful, and that reëxcisions are seldom, if ever, justifiable. It must be admitted that there is some justification for their opinion, but, on the other hand, nothing else has ever been offered, with the possible exception of the x-rays, that may be considered to have the slightest influence upon the fatal progress of this disease. It therefore seems worth while, and for the reasons given, to try the radical sequential treatment proposed by Bunting and Yates.

They lay the greatest emphasis upon attention to the portal of entry, and warn that nothing else short of the plan proposed offers any criteria for the judgment of results by operation. The portal of entry *must* be eradicated, the excision *must* be thorough and not partial, and the roentgen-ray treatment *must* be intensive and skilfully applied. Under no circumstances are "test excisions" to be made except in doubtful cases, and then only when the surgeon is prepared to follow a frozen section diagnosis immediately with a radical extirpation, or in exceptional cases when an accurate histological estimation of the nature of the process is of sufficient value as an aid to therapeusis to balance the danger. Such wounds should be treated with the roentgen rays immediately and repeatedly, as even in acute cases the liability to dissemination is thus reduced materially.

In respect to the serum, Bunting and Yates justify its use on empiric grounds. The patient who tolerates the serum seems to improve more rapidly and to receive more permanent benefit than from the same general treatment without the serum. They state that medications of any kind are without use, and that fresh air, sunshine, and proper feeding are infinitely superior to any drugs.

In regard to the roentgen rays, Bunting and Yates make but little reference except to urge its proper intensive use. Simmons and Benet seem to have worked almost entirely with advanced cases, the average duration of their cases, before applying to them for treatment, was eighteen months. They found that treatment by radium and by the x-rays is followed by a marked temporary amelioration of symptoms, by a diminution of the size of the glands, and by improvement of the general condition, and they admit that, in the majority of the cases, it has not prevented the progress of the disease to a fatal termination. Of 19 cases, 14 are dead and 5 are under treatment. They think that from the very first there should be systematic treatment of all the glandular regions of the body whether there is evidence of enlargement of the glands or not; it is useless to treat those of the neck, for instance, and ignore those of the mediastinum. In comparing the x-rays with radium, they state that the impression is that the patient improved in

general condition, and the glands treated diminished in size with the *x*-rays, but that the improvement is not as marked as with radium.

The *x*-rays, when measured, were usually given at a distance of 25 cm. through an aluminum filter and with a brass cone. The voltage was 70 K. V. Radium was given in treatments of 60 to 1000 or more milligram-hours. The impression one gets from reading their article is that they are not satisfied with the methods of the past and are changing them.

Holding and Brown also state that the treatment of Hodgkin's disease is extremely unsatisfactory. They state that surgical removal is only local in its action and constitutes more or less of a shock or drain on the patient's vital resources. They do recognize, however, complete excision and diagnosis by microscopic section in the earlier stages while the lesion is restricted to a single locus, followed by prophylactic Röntgen treatment, together with the searching out and the elimination of all possible foci of infection.

They recommend the most extensive roentgen treatment in all of these cases immediately after the diagnosis is established; the rays are given over the lymphatic structures of the body. They state that the matter of roentgen-ray dosage has not been settled, and, while they were able to get an increased dosage Coolidge tube and are able to get the symptoms under control more quickly, yet they are not convinced that the therapeutic results in Hodgkin's disease are not more lasting than they were formerly with less desirable apparatus. At present they are giving the massive dose at the beginning of the treatment, and continuing them until the symptoms are controlled and then giving more moderate doses to keep the development of the disease in abeyance.

In a discussion on the paper by Bunting and Yates, Foerster⁹⁹ summarizes the technic of *x*-ray treatment as follows: "Five milliampères of current are passed through a Coolidge tube. The spark gap is $8\frac{1}{2}$ x 9 inches. The body is divided into various areas (I prefer six), all of which are given a treatment on the same day. The target of the tube is 12 inches from the skin surface, and the time of application for each dose which approximates the erythema dose (just short of as much as the skin will stand) in eight minutes. Six such treatments are given in one day to various regions (axillæ, groins, cervical) with exclusion of the splenic area, and the rays are directed at such angles as to cross each other at the desired location in the depth (cross-fires). The dose is repeated after ten to twelve days.

The rays must be filtered through leather and through aluminum (4 millimeters of aluminum and 3 of leather) so as to exclude the soft or injurious rays. The rest pass through without injury to the skin, and reach the areas in the depths which we wish to influence."

Dr. Yates, in the same discussion, made the interesting observation that E. A. Smith had developed a method of taking pictures on the bias so that the mediastinum is shown so clearly that an early diagnosis is possible. At this time no picture in an anteroposterior direction, however well taken, developed, and interpreted, can reveal these changes.

⁹⁹ Wisconsin Medical Journal, 1917, xv, 462.

Exophthalmic Goiter. There is nothing very noteworthy to present this year regarding this interesting disease. The writings of Crile continue; there are several papers on technic, and some further researches by Kendall.¹⁰⁰ I have been much instructed by a paper from Reede¹⁰¹ who, after summarizing the work of Cannon, Kendall, and DuBois, correlates the effect of excessive function of the thyroid, the suprarenal glands, and the cervical sympathetic nervous system. He outlines the continuity of events leading up to exophthalmic goiter, as follows:

"1. A period of infection leading up to hyperplasia of the thyroid and a goiter with, or without, symptoms, beginning often in childhood.

"2. A period of increased physiological demand inducing hyperthyroidism.

"3. The stage of rapid metabolism and highly sensitized bodily function known as hyperthyroidism.

"4. The period of emotional stress in which originate the stimuli to suprarenal secretion.

"5. The stage of suprarenal oversecretion with the appearance of general sympathicotonic symptoms and the localization of the brunt of the effect on the cervical sympathetic.

"6. The stage of degeneration and the breaking down of the cardiac, mental, visual, nervous, thyroid, and suprarenal mechanisms."

Reede then offers these deductions as the result of the above inferences:

"1. I feel strongly that some definite attempt should be made to protect the thyroids of girl children, from five years up, against the bacterial injury from mouth and nearby infections.

"2. A child with a hypertrophic thyroid or goiter faces the possibility of developing hyperthyroidism under such metabolic strain as that of puberty, and deserves that that physiological stress be lightened by careful supervision.

"3. A young woman with a goiter and hyperthyroidism runs a certain danger of developing toxic hyperthyroidism or exophthalmic goiter, and a determined endeavor should be made by psychotherapy, physical and mental rest to bring the metabolism down to normal. Environmental neutrality and insulation against psychic trauma should be assured, if possible.

"4. If the hyperthyroidism develops in the direction of sympathicotonia, the presumption of impending exophthalmic goiter is so strong that grave consideration is warranted.

"5. If operation is determined upon in exophthalmic goiter, it should be done at the earliest moment and should be bilateral and adequate.

"6. It must be accepted that operation after the first year of active exophthalmic goiter must not be expected to remedy symptoms which arise from other organs than the one removed at operation.

"7. After the fourth year the thyroid is usually exhausted and under-secreting, which may be true of the adrenals as well, and careful observa-

¹⁰⁰ *Journal of the American Medical Association*, lxi, 612.

¹⁰¹ *Medical Record*, 1917, xci, 450.

tion is merited by symptoms which may in no direct way be arising from thyroid secretion."

THE KINETIC DRIVE AND EXOPHTHALMIC GOITER. This fascinating theory, mostly elucidated by Crile, enables us to plan a form of treatment, partly surgical, which has given results far superior to any other treatment in this disease. It is hardly necessary to describe the theory; in fact, it is impossible to present it adequately in abstract. The practical aspects are well described by Crile¹⁰² in his recent papers. His clinic has had an experience of 1020 cases of exophthalmic goiter so classed because they present, at the time of operation, symptoms of increased basic metabolism not due to any current exciting cause, and the symptoms being relieved or cured by diminishing thyroid activity. In his series every recovered case was benefited and in the vast majority the disease was definitely arrested.

"In an extreme case the initial surgical step is the injection by Porter's method of a small amount of boiling water into one lobe. This is done with the patient in bed under local anesthesia and nitrous oxide analgesia. The effect is noted and if the indication is favorable a larger injection is made into the other lobe, this being followed by a still larger injection into the first lobe. If all goes well, one superior thyroid artery is ligated or else one pole is ligated after the method of Stamm and Jacobson. Later, the opposite side is treated in like manner. All these procedures are done under analgesia and local anesthesia with the patient in bed.

"The patient may then be sent home that the organism may have a chance to adjust itself to the lessened thyroid activity. During this period of rest there is usually a striking gain in weight; the edema disappears; the pulse rate falls; the widely dilated heart and the enlarged liver grow smaller; the sensitization of the brain lessens; and the size of the thyroid diminishes.

"Some patients improve so much during this 'interregnum' that they are loath to return for the lobectomy; but without lobectomy relapses are apt to occur.

"Like the preceding maneuvers the lobectomy is performed under the strictest anociation. The patient receives a preliminary dose of morphine and scopolamine, and is transported to the operating room under light nitrous oxide anesthesia. The local field is blocked by novocaine; the divided tissues are infiltrated with quinine and urea hydrochloride; and the manipulation and dissection of the operation are performed in the gentlest possible manner.

"The patient is returned to bed while still under light anesthesia. Under novocaine a large saline infusion is given under the breast and water by mouth is urged. If not annoying to the patient, a 5 per cent. glucose and 5 per cent. sodium bicarbonate solution is given by the Murphy drip.

"Special tact and skill on the part of the nurse are required to guard

¹⁰² Journal of the American Medical Association, 1917, lxi, 610; Ohio State Medical Journal, 1917, xiii, 7.

against restlessness and insomnia. If these cannot be controlled, morphine should be given in sufficient quantity to secure the desired result.

"Rest, sleep, water and alkalies are the essential foundation stones of ultimate repair.

"In accordance with the kinetic theory, every activation must be reduced as much as possible. Work—mental and physical—and worry must be minimized; every focus of infection, tonsils, sinuses, etc., must be cleared up; much water must be taken; a non-protein diet prescribed and diversion encouraged. The period of directed postoperative rest should continue for about a year. In short, the fundamental principle of the treatment of this excessively kinetic disease, in which the body is ultimately driven to its own destruction, is its antithesis—*rest*."

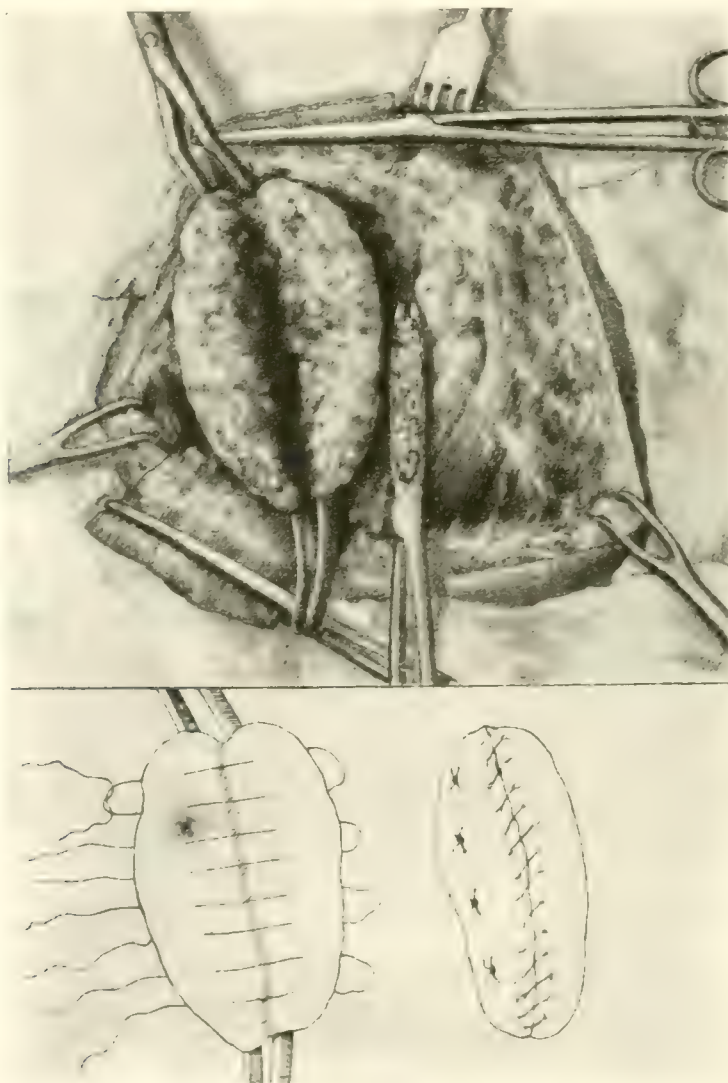


FIG. 2.—A (above). Goiter clamp grasping resected lobe. Clamp on isthmus; B (lower left), mattress sutures in place; C, lobe reconstructed.

He also states that "in the most serious cases not only the first but each step of the graded operation is performed with the patient in bed—ligation in bed, lobectomy in bed. The operating room goes to the patient. Moreover, in serious cases we now leave the wound open, guarding against infection by applying dressings moistened with neutral

solution of chlorinated soda for from twenty-four to forty-eight hours, the wound being then closed under analgesia in bed. That is to say, we literally make operating 'rounds' giving a devitalizing injection of hot water or of quinine and urea hydrochloride here; doing a ligation there; performing a lobectomy in another room; closing a wound in still another."

RESECTION OF THE THYROID GLAND. In order to safeguard the recurrent laryngeal nerves and the parathyroids, many surgeons follow the Balfour technic, resecting the anterior parts only of one or both lobes. Pool¹⁰³ has found that in many cases the use of a clamp, similar to a Scudder gastric clamp, facilitates the technic of resection by lifting and steadying the lobe and controlling hemorrhage. The lobe is freed, with or without ligation and section of the superior vessels as the case demands; the isthmus is cut across and its stump separated from the trachea, the lobe is then grasped well back by the clamp, which is placed vertically with one blade on each side of the lobe. The clamp has long delicate blades so as to lightly grip, but not crush, the thyroid; it has a broad clutch by means of which it may be locked while the blades are comparatively far apart, as in grasping a broad lobe; the bayonet shape allows the blades to be introduced more readily into the wound. (See Fig. 2.)

In large, diffuse, simple goiters he practises double resection as the procedure which most closely meets all indications.

LIGATION OF THE INFERIOR THYROID ARTERY. Stewart¹⁰⁴ advocates ligation of "the inferior thyroid artery behind the carotid sheath in preference to ligation of the superior thyroid artery in those cases more suited to vessel ligation than lobectomy, for here we have diminution in blood supply to two toxic glands instead of one, and, in addition, we have a field prepared that gives us little to fear from hemorrhage, thymus vascular trouble or chest pain, if the patient later comes to lobectomy."

I myself believe that in regard to this ligation the superior is to be preferred to the inferior for the reason that I believe there is more to the operation than the mere blood supply. We know what a tremendously rich blood supply the thyroid gland has and how little it can be affected by the ligation of one of its six or more bloodvessels. So that while for cosmetic reasons the ligation of the inferior pole is the more desirable, the clinical results, I believe, will be infinitely superior if we elect to ligate the superior pole.

Certain features of the technic are ably brought out by Judd, of the Mayo Clinic. After calling attention to the danger of allowing the inferior thyroid vessel to slip under the cervical fascia, he states that even the smallest vessels should be ligated because the slightest oozing may produce a clot, tracheal pressure and difficulty in breathing.

TRACHEAL COLLAPSE. Judd advises that, if this occurs, the "fascia over the trachea should be grasped on each side with a hemostat and the collapsed rings pulled apart. Usually, after the lumen has been reëstablished in this way, it will be maintained without further diffi-

¹⁰³ Surgery, Gynecology and Obstetrics, 1917, xxiv, 150.

¹⁰⁴ Pennsylvania Medical Journal, 1917, xx, 751.

culty. If the trachea persists in collapsing or has been injured it may be necessary to make a tracheotomy and keep a tube in place for a few days. Formerly, it was considered necessary to dissect the thyroid tissues off from the trachea and cartilages as closely as possible, but recently, we have found that if we preserve the fascia about the trachea and larynx and possibly leave some thyroid tissue over the cartilage, the post-operative convalescence is much easier, coughing and irritation is less and the accumulation of mucus in the trachea and larynx is greatly diminished. This is a very important factor in the technic of thyroidectomy."

INJURY TO THE RECURRENT LARYNGEAL NERVE. He has found it important to know the condition of the vocal cords before operating because a paralysis from the goiter pressure may exist and the patient be unaware of it by reason of the developed compensatory action of the other cord. It is imperative to avoid even the slightest amount of traumatism to the good nerve in such cases.

"In all probability the loss of voice after goiter operations is frequently due to a change in the position of the larynx and the trachea by the removal of the thyroid. This is especially true if there has been a great deal of pressure from the growth, or edema and swelling in the tissues after the operation. Fortunately, the laryngeal muscles seem to have a tendency to hypertrophy, and carry the arytenoid on one side across the midline to its opponent, even though the opponent may lie almost motionless on account of the incapacity of the muscle on that side. The restoration of the voice after the laryngeal nerve has been severed or traumatized, I believe is due to this hypertrophy and the increased function in the good cord rather than to restoration of function in the traumatized side." (Judd.)

INJECTION TREATMENT OF GOITER BY BOILING WATER. The use of boiling water as a method of treatment in goiter is now well-known and is occasionally used by the Mayo Clinic, Crile, and others. O'Day¹⁰⁵ has treated 17 cases and in all nothing but good has resulted. The object, it will be remembered, is to destroy the secreting epithelium of the acini. Olicieri and Ronchi¹⁰⁶ had good results in 4 cases, and Ceballos and Bacigalupo¹⁰⁷ report 6 cases so treated with material improvement.

The technic followed by O'Day is as follows:

"That no fumbling occurs while the hot water is being injected, three or four rings cut from large rubber tubing are slipped over the barrel of a 10 c.c. glass syringe; wearing two pairs of gloves, cotton inside of rubber, the operator is enabled to work without fear of burning his hands. From the time the syringe is lifted out of the sterilizer until the water has been injected, no time must be lost, for, unless the water be hot enough to cook the tissue into which it is injected, its purpose will be defeated.

Before the process of "cooking" has begun, the surgeon should have

¹⁰⁵ *Annals of Surgery*, 1917, lxy, 279.

¹⁰⁶ *Pres. Med.*, Argentina, 1917; abstract in the *Journal of the American Medical Association*, 1917, lxi, 949.

¹⁰⁷ Abstract in the *Journal of the American Medical Association*, 1917, lxi, 2076.

definite plans at hand for the attack. Remembering the good results obtainable by the Stamm-Jacobson operation of ligating the superior poles, we are now in the habit of beginning the cooking at the upper pole, each succeeding injection being carried downward, the needle point being so directed at each selected level that the destruction of the gland is wrought in strata. Unless some such order is maintained, one may be unconsciously reinjecting the same point, thereby hindering the systematic part by part destruction necessary in securing satisfactory results. When the gland is small, making the injections more or less uncertain, unless the condition of the patient be very severe, we have been able to obtain splendid results by exposing the thyroid and cooking it directly under the eye. This can be accomplished without elaborate preparation, under local anesthesia. With the gland exposed in this way, the effectiveness of the process can be fully appreciated. As the boiling water is being injected, the corresponding portion of the gland is seen to whiten into a bloodless pulp-like mass."

INJECTION OF QUININE AND UREA HYDROCHLORIDE. Watson¹⁰⁸ reports the results of 100 cases treated by the injection of this drug. Of the exophthalmic type, 80 per cent. were believed to be cured, and 15 per cent. improved; of the non-exophthalmic group, 75 per cent. were cured and 12 per cent. improved. "Preliminary injections of sterile water and normal salt solution were used in the toxic patients to lessen the danger of acute hyperthyroidism. The injection is not suited to all types of goiter, and, unless used discreetly, it will be disappointing, if not disastrous. There is always the danger of provoking an attack of acute hyperthyroidism. The toxic cases should be watched carefully and at the first sign of an acute exacerbation of hyperthyroidism, treatment should be stopped, a hypodermic of morphine and atropine given, ice-bags applied over the thyroid and heart, and the room darkened."

INJECTION TREATMENT BY PHENOL. Sheehan¹⁰⁹ states that "enlargement of the thyroid gland, particularly that form occurring in young women, can be cured, or at least the symptoms of the enlargement can be greatly minimized by these injections." He has treated 17 patients with injections of a mixture of 5 drops each of carbolic acid (C. P.), tincture of iodine and glycerin into the most prominent part of the goiter, usually at five-day intervals. In many of the cases, five injections suffice. The patient complains of pain and swelling, terminating in soreness after twenty-four hours; if continued, ice locally and codeine internally will promptly give relief. No untoward symptoms have ever been observed. He combines the injections with a course of arsenic and some form of phosphates. Moore¹¹⁰ also uses phenol in non-toxic goiters (evidently the goiters of adolescents) and speaks of it as the "Gunn method." He administers iodine internally and externally for a period of not more than four weeks. Then a 5 per cent. solution of phenol is injected into the gland substances, one or two injections of 60 or 100 minims usually being sufficient to affect a permanent cure.

¹⁰⁸ New York Medical Journal, 1917, cvi, 549.

¹⁰⁹ Medical Record, 1917, xcii, 591.

¹¹⁰ Northwest Medicine, 1917, xvi, 172.

If the gland is still enlarged after 10 or 12 injections, it will be useless to continue.

Tuberculosis of the Thyroid Gland. An excellent recent paper has appeared on this subject by Mosiman,¹¹¹ who reports the experiences of Crile's clinic. He reports 9 cases, all but 2 of which were diagnosed clinically as exophthalmic goiter, and these were diagnosed as sarcoma and as hypertonus. His cases are described in great detail both from the clinical and the histological aspect, but present nothing of importance that would enable one in similar cases to make the correct diagnosis. He suggests that it is doubtful that there is a true primary tuberculosis of the thyroid gland. The 9 cases reported comprise a tuberculous involvement of less than 1 per cent. of the operative material.

Abscess of the Thyroid Gland. Three cases are reported by Lahey.¹¹² Besides the symptoms of local infection there were two constant signs which he believes are of great significance in cases suspected of thyroid abscess. These are limitation of chin elevation and depression of the chin on the sternum when swallowing.

"They are brought about by the action of the sternohyoid, sternothyroid, and omohyoid muscles on the abscesses beneath them. From the diagrammatic drawing, one may easily perceive how the pain may result from tightening of these muscles, and how tightening as the result of swallowing may be prevented by depression of the chin upon the sternum.

"The treatment of these cases is simple incision and drainage. It is important, however, to dissect carefully down to the gland, under local anesthesia, and to cut the fibers of the sternohyoid transversely for a short distance on each side of the median line, as on account of the longitudinal tension of the sternohyoid and sternothyroid there is a tendency for any other incision to come together, thus interfering with drainage. On establishing drainage, recovery was rapid and uneventful in these cases."

Dowd¹¹³ has seen 4 examples of thyroid abscess. "One was fatal from an overwhelming streptococcus infection; two others had very severe constitutional symptoms, but finally recovered after liberation of the pus; the fourth, who came to the hospital earlier than the other patients, illustrated the development of staphylococcus infection in chronic goiter. After two weeks of increasing tumefaction, fever and discomfort in the neck, the thyroid showed a large intracapsular abscess in each lobe. There was no apparent communication between the abscesses. A large portion of the glandular tissue was destroyed by the suppuration. Prompt recovery followed the opening of the abscesses."

THE MAMMARY GLAND.

Intracanalicular Papilloma of the Breast.—A bloody discharge from the nipple may be a symptom of one of several affections of the mammary

¹¹¹ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 680.

¹¹² *Boston Medical and Surgical Journal*, 1917, clxxvi, 94.

¹¹³ *Journal of the American Medical Association*, 1917, lxi, 614.

gland. Judd,¹¹⁴ in reviewing 100 consecutive cases of discharging nipples, found 50 in which a bloody discharge was present, and 50 which had other forms of discharge from the nipple. The underlying condition was as follows:

	50 cases of serohemor- rhagic discharge from the the nipple.		50 cases of other forms of discharge from the nipple.	
	Cases.	Per cent.	Cases.	Per cent.
Carcinoma	27	54	30	60
Chronic cystic mastitis	12	24	14	28
Intracanalicular papilloma	8	16	4	8
Paget's disease	3	6	0	0
Simple cyst	0	0	2	4

Papillary cystadenoma has long been recognized and was very well described some years ago by Greenough and Simmons. The Intracanalicular papilloma is not so well known among clinicians, but, as Judd points out, they only differ in their point of origin, the former arising from the walls of the acini and the latter from the walls of the milk ducts. In the Mayo Clinic they have had 32 cases of papilloma of the breast, carcinoma being present in 11, and probably so in 3 others, the characteristic symptom being a bloody or serohemorrhagic discharge from the nipple. Carcinoma is the most common lesion producing a discharge from the nipple but it is almost invariably associated with a tumor in the breast. In a few of the papillomas there were palpable tumors, but in all of them the growth was produced by chronic mastitis or by cystadenoma, and in no case was there a papilloma in the duct large enough to be palpated except in one case, in which it extruded from the nipple. Therefore a hemorrhagic or serohemorrhagic discharge from the nipple in the absence of a palpable tumor is most often produced by benign intracanalicular papillomas. Judd advises that treatment should be conservative, especially in young women. In older women, particularly if the condition is associated with chronic cystic mastitis, the best procedure would seem to be the removal of the mammary gland. If there are evidences of malignant change, a radical operation should be done.

Paget's Disease of the Nipple. Much has been written upon this affection and many theories constructed of its etiology. Probably most of us believe in the theory of Thin (1881) that the cancer located in the region of the ducts discharges onto the skin, its irritant action producing the eczema. Handley,¹¹⁵ in his Hunterian Lecture, develops the idea that Paget's disease is due to lymphatic edema of the nipple dependent on the blocking of the lymphatics by permeation extending from a preëxisting carcinoma of the breast. He pictures the pathology in this wise:

"A carcinoma starts in the smaller ducts of the breast, perhaps exceptionally from the acini or the larger ducts. Usually, without

¹¹⁴ Journal-Lancet, 1917, xxxvii, 141.

¹¹⁵ Lancet, 1917, i, 519.

producing a palpable tumor, it permeates the breast lymphatics widely. The rich plexus of lymphatic vessels around the ducts forms an especially easy and convenient channel for permeation, and the lymphatic block extends along them to the subareolar plexus beneath the nipple.

"The cutaneous lymphatics about the nipple are now dammed up so that lymph cannot return from them. Later they are themselves permeated, but possibly this is not always the case. At this stage, and before any lump has appeared in the breast, the skin of the nipple and the mucosa of the ducts begin to show changes dependent upon lymphatic obstruction. The epithelium shows disintegration and degeneration of its superficial layers with proliferation of the deeper layers. These changes are nutritional and non-malignant. The dermis becomes thickened by solid lymphatic edema. The lymphatics of origin in the superficial layer of the dermis may be found filled with cancer cells, which are also to be seen in the lymphatics of the subareolar plexus.

"The permeated lymphatics now undergo the usual process of perilymphatic fibrosis; they become surrounded by aggregations of inflammatory round cells, and later by young fibrous tissue, which contracts upon and destroys the included cancer cells. In most cases, at the time the disease is removed the destruction of the cancer cells has been consummated, and there is seen merely a band of round-celled infiltration in the superficial dermis, while in the deeper dermis perivascular aggregations of round cells indicate the destruction of the lymphatics which are known to accompany the bloodvessels in this layer. In other and later cases organization into fibrous tissue is complete, round cells have disappeared, the papillae have been destroyed by the fibrous contraction which has taken place in them, and nothing remains to show that the lymphatic vessels of the dermis have been obliterated and replaced by fibrous cords save, and except, the persistent changes in the epithelium and the edematous thickening of the dermis.

"In regard to the changes in the large ducts, these are evidently similar in nature to those found on the surface of the nipple, and they depend upon the same cause, namely, lymphatic obstruction from permeation and subsequent fibrosis. The only difference is that the shed epithelium cannot get away, and it remains *in situ*, plugging and distending the ducts with a degenerate mass of débris.

"Lastly, even in the rare cases where, though Paget's disease has lasted many years, yet no carcinoma has made its appearance, it is probable that an atrophic scirrhus which may have undergone partial or complete cure, preceded the onset of Paget's disease. But the possibility that the lymphatic obstruction in such cases is of inflammatory origin, and due to a chronic lymphangitis, cannot be altogether excluded."

In regard to *treatment*, Handley concludes, in the light of the above, that the radical or complete operation is indicated.

Sekigucki¹¹⁶ reports on conclusions after a study of 18 cases from Kondoh's clinic in Tokyo and from the Mayo clinic. He believes that

¹¹⁶ Annals of Surgery, 1917, lxx, 175.

Paget's disease is a primary carcinoma of the orifices of the lactiferous or the sudoriferous ducts. He was enabled to examine the lacteal duct in the very early stage, and always found a peculiar proliferation and desquamation of the duct epithelium in its superficial part, accompanied by irregularity of the shape of the cells. Peculiarities of the stroma resist alveolar formation and lead to confusion, but he maintains that the epithelial alteration is a primary carcinoma which later invades the epidermis, causing the skin affection, and the deep layer, forming typical cancer rows when the resistance and reaction of the stroma is weaker than that of the nipple. The article is well illustrated.

The Element of Error in the Diagnosis of Mammary Conditions. One commonly reads statements from surgeons who have compiled statistics from a series of cases of carcinoma of the breast regarding the failure of the general practitioner to diagnose breast cancer sufficiently early to give operation a chance. Very often the most scathing terms are used in condemnation of the delay in diagnosis. If every patient was advised that the "lump" in the breast should be removed at once, there would be no occasion for criticism, but the trouble is that the general practitioner attempts the diagnosis between malignancy and benignancy, often is mistaken, and then must bear all of the odium when recurrence occurs. It is interesting, therefore, to read the recent papers on the legitimate actual error, the apparent error, and the avoidable error by MacCarty and Broders.¹¹⁷ It should be remembered that these men are discussing a large series of cases observed in the Mayo Clinic. The actual error consists in a clinical diagnosis of a malignant condition when a benign condition really exists, or *vice versa*, and the error is inevitable and unavoidable because it is not possible always to differentiate benign from malignant conditions by any known clinical methods. Twenty-two per cent. of the mammary carcinomata were not diagnosed as malignant by the clinicians. The writers therefore urge that surgical work on the breast cannot be done efficiently or justly without accurate gross and microscopic examination by a skilled surgical pathologist during the operation. In the second paper they condemn the efficiency of the gross appearance as the sole means to diagnosis and state that, in a series of consecutive examinations of 1582 cases, it was absolutely necessary for them to make microscopic diagnosis in 29.3 per cent. In the paper on the "apparent error" they call attention to the failure of the clinician to recognize many well-known pathological conditions, and especially to the percentage of error in terminology. In their fourth paper they summarize their solution of the problem, but after all is said they actually only urge a decision to be made by the surgical pathologist during the operation. These four papers represent a splendid idea and contain much material for thought, but the writers have failed to present the matter clearly, and the only valuable part is the tables which enable us to draw our own conclusions.

Evolution of Cancer of the Breast. Syms¹¹⁸ discusses the life history of the mammary gland and calls attention to the lack of equilibrium

¹¹⁷ Surgery, Gynecology and Obstetrics, 1917, xxv, 666.

¹¹⁸ Journal of the American Medical Association, 1917, lxix, 454.

of its epithelium. He considers chronic cystic mastitis as a complete process, evidenced by signs of inflammation, of hyperplasia of the different elements, by cyst formation, etc., and that its last stage is carcinoma. He supports the hypothesis that cancer of the breast is caused by some form of irritation which first results in chronic cystic mastitis, and which finally results in cancer by a form of transition from one stage to another until the final stage of infiltrative cellular hyperplasia, which is cancer.

These statements must not be understood as meaning that every breast the seat of chronic cystic mastitis must be sacrificed; the evidence of cancer must be reasonably certain. Eisendrath pointed out this in the discussion. I have previously stated that all of my cases diagnosed in the laboratory as cystic mastitis remained well even though a conservative operation had been done. I note that Pilcher¹¹⁹ reports 14 cases of non-malignant tumors (fibromata, cysts, cystic mastitis, etc.), all of which remained well. I know that chronic cystic mastitis is frequently accompanied by a malignant hyperplasia of the epithelium, but it has not been proved that it is the precancerous stage of cancer. I do not understand what Syms means by making "a distinction between the hard tumorous masses we find in this disease and true tumors." He says they are a peculiar form of neoplasia, and are not tumors at all, though they may have a typical appearance under the microscope.

TECHNIC OF THE OPERATION FOR CANCER OF THE BREAST. There have been two papers published during the year, one by Pilcher¹²⁰ and the other by Willy Meyer,¹²¹ which, though offering little that is new, go over the ground thoroughly and represent individual opinions about current operating methods. The principle of the radical operation for cancer of the breast is involved in the method for dealing with the deep tissues, the skin incision being varied only with a view to the exposure of the diseased focus and the proper closure of the defect. As is well known, the Halstead operation was well known for many years before the method of Meyer became current. The essential difference is that Meyer works from the axilla to the sternum and removes the two pectoral muscles *with* the tumor plus lymphatic glands and fat *in one piece*, whereas Halstead works from the sternum to the axilla, preserves parts of the pectorals and disturbs the *en bloc* dissection. In this paper Meyer reports the results in 68 out of 78 private patients operated on; 22 (32.35 per cent.) remained well and free from recurrence from four to twenty-two years after operation.

In his remarks upon technic, Pilcher considers the elements essential to permanent success, viz.: "(a) Complete removal of the primary focus of disease; (b) avoidance of carcinoma implantation upon the fresh tissue surfaces exposed by the dissection; (c) the interruption of possible progressive metastasis by the routine removal of the first chain of lymph nodes which receive the absorbents from the area in which the primary focus lies; (d) the use of incisions in the primary steps of the operation

¹¹⁹ *Annals of Surgery*, 1917, lxx, 654.

¹²¹ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 553.

¹²⁰ *Ibid.*

that will facilitate the formation of plastic flaps that may be used to cover the raw area remaining."

A. *Complete Removal of the Primary Focus of Disease. The Axillary Lymph Nodes.* "The systematic removal in all cases of all the gland-containing tissue of the axilla in an unbroken piece, continuous with the tissue containing the breast itself, is now recognized as a procedure of as much importance as the removal of the breast itself, as a part of the indication to be satisfied in securing the complete removal of the primary focus of the disease." (Pilcher.)

The Pectoral Muscle. Pilcher quotes from Heidenhain relative to the involvement of the muscles, and it is interesting to recall to mind the contrary opinions held by the late Dr. Murphy. I have referred to this before in some detail.¹²² "No question, therefore, in our judgment, can now attend the dictum to include the removal of the pectoral muscles, major and minor, in a continuous piece with the breast as a part of the routine technic in all operations for carcinoma of the breast." (Pilcher.) Meyer also "favors the complete removal of both pectoral muscles in every instance. He goes further and advocates the *total* extirpation of the pectoralis major muscle, including the clavicular portion. He does not at any time work within the spaces *between* the two muscles, but leaves this area entirely undisturbed by extirpating both muscles together and entirely."

The Skin. The early advocates of radical operation advised a wide removal of the skin to be followed by skin grafting if the flaps could not be brought together. I remember an experience attributed to Halstead, *viz.*, that the surgeon who has to suture the wound should not be the same as he who removes the skin. Later, however, Handley showed that the tendency of cancer to spread centrifugally along the skin itself is quite insignificant, but that the important route for its spread is in the lymphatics of the deep fascia. Wide removal of the fascia is therefore of paramount importance. Pilcher agrees with Handley "that the necessary indications for the removal of skin can usually be fulfilled by the removal of a circular area of skin four or five inches in diameter centered upon the growth, not upon the nipple. Such an area of skin is outlined by an ovoid incision with its narrower diameter four inches or more, which is carried through the skin and the thin area or areolar fatty tissue just underneath, as the first step in the operation for the removal of a growth in a breast."

B. *Avoidance of Carcinoma Implantation upon the Fresh Tissue Surfaces Exposed by the Dissection.* The removal *en bloc* of all tissue under suspicion has become the rule among surgeons and I think is the main reason why Meyer, Rodman, and others, work downward from the axilla. Both Pilcher and Meyer practice excision of the upper portion of the rectus sheath as advocated by Handley.

C. *The Routine Removal of the First Chain of Lymph Nodes.* As a rule the lymph nodes for a long time delay the progress of any cancer cells which reach them, so that any operation which takes the whole

chain out of the axilla before the adjacent tissues have become involved may be regarded with much certainty as having gone outside of the area of infection in that direction.

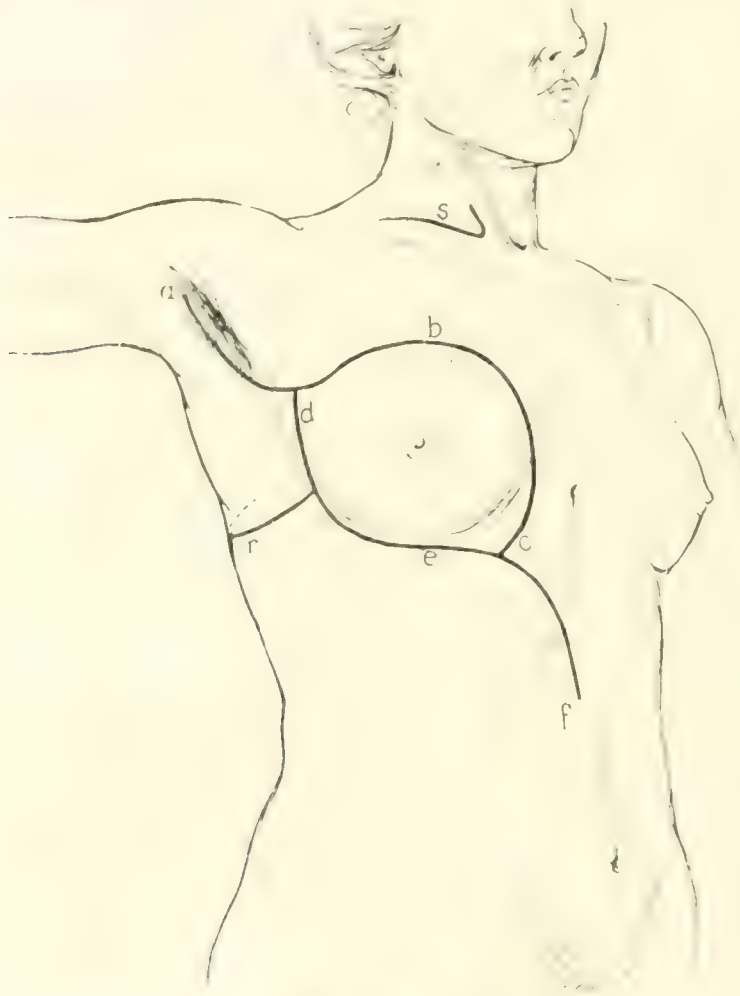


FIG. 3.—The Pilcher incision.

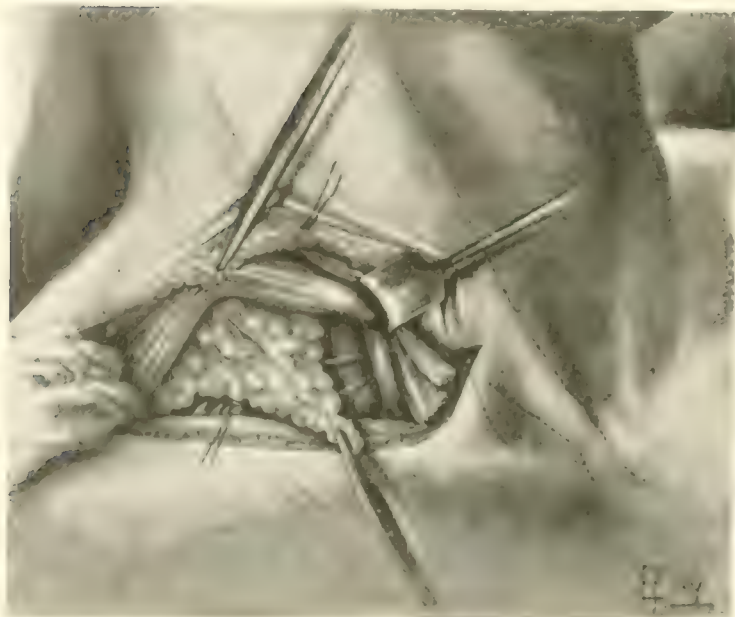


FIG. 4.—Dissection of supraclavicular gland-bearing tissue. This is done as the first step of the operation.

The supraclavicular nodes still remain debatable ground. Pilcher follows these rules: "Regardless of whether or no enlarged nodes may be palpated above the clavicle, the supraclavicular space should be opened and its fat lymphatic tissues removed:

"(a) Whenever the superior axillary and the subclavian group of lymph nodes are infected to a pronounced degree.

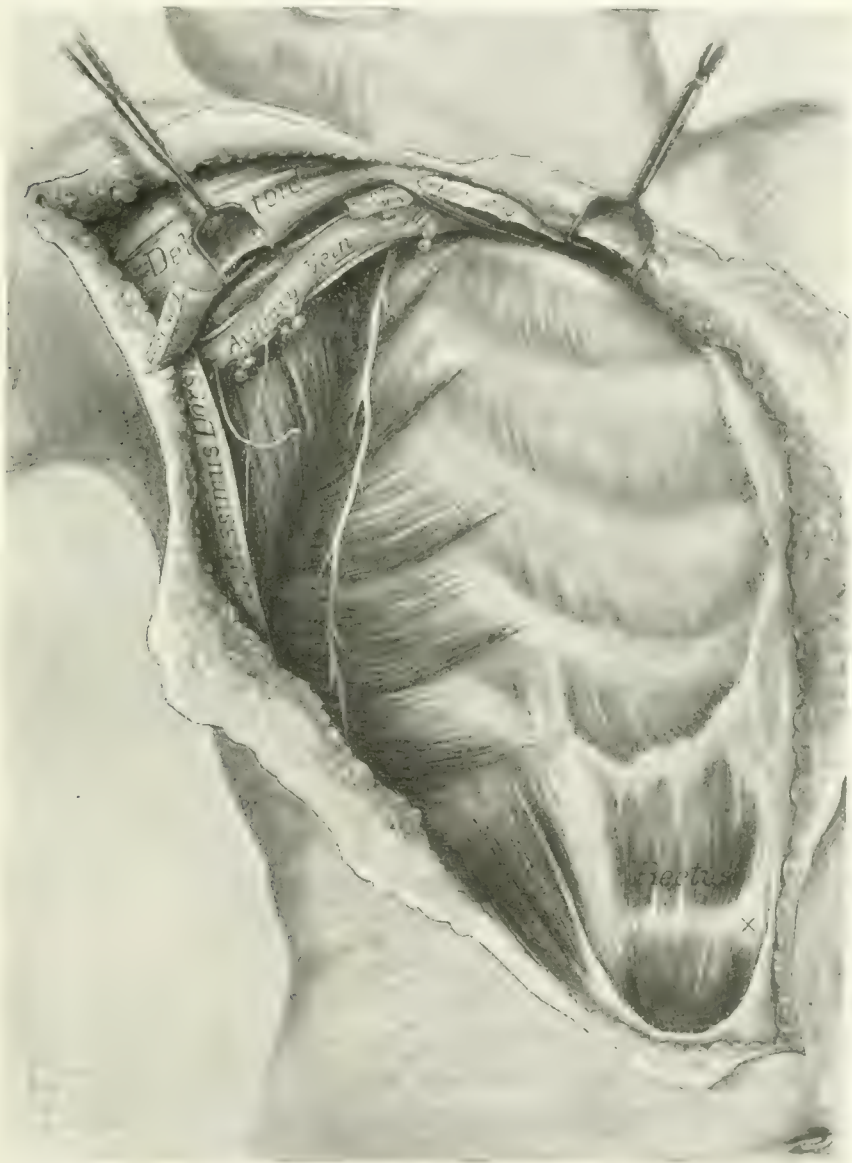


FIG. 5.—Showing the area exposed at the completion of the recommended operation for carcinoma of the breast. The axilla has been cleared; the pectoral muscles with overlying breast have been removed; the fascia covering the upper third of the rectus muscle has been taken off. The cross (X) marks the site of the weak epigastric spot.

"(b) Whenever the primary focus of breast infection is in the upper hemisphere of the gland and well advanced in its development.

"(c) Whenever the disease in the breast, whatever its primary location, has involved the upper hemisphere, and the growth is judged to be still operable."

The rationale of the first rule lies in the fact that when these lymph nodes are converted into a carcinomatous mass, the normal pressure upon

the channels that lead up over the clavicle on the front of the thorax is exaggerated and thus the possibility of direct transfer of carcinoma already in the breast is increased.

The second and third rules are indicated because the anatomists have shown the frequent presence of a set of lymphatics which share in the drainage of the upper half of the breast and pass upward in front of the clavicle to the deep-lying supraclavicular nodes. In such instances the supraclavicular nodes will form a part of the first line of defence equally with the axillary nodes, and should be as a routine included in the tissues to be removed.

Pilcher finds that "the deep situation in the neck, covered over by the dense cervical fascia, makes it impossible to detect them by palpation through the skin until they have become materially enlarged by the progress of the carcinomatous process in them, which means at a comparatively late date when further permeation of the carcinoma beyond their borders may have already taken place. If the surgeon waits until they have become large enough to be detected by his finger-tip applied to the overlying skin, there is therefore greater possibility that the period during which their removal would be definitely efficient to remove all the disease will have passed. If the surgeon opens the base of the neck (Fig. 4), as he does the axilla, he will fail to find any indication that the supraclavicular nodes are involved in many of them, but, on the other hand, he will find in occasional instances diseased nodes which otherwise would have escaped detection and would have remained to defeat the most extensive and well-carried-out operation in other respects. To feel that one has done an unnecessary operation is never agreeable to any surgeon, and such would often be the situation of the surgeon who opens the base of the neck in all cases; but to find in the future history of a case that one has omitted a most important and vital portion of surgical effort, a part which could readily have been done without adding materially to the risks of the operation, must be far more disagreeable."

Willy Meyer believes that "the removal of the supraclavicular glands does not, however, seem absolutely called for as a routine measure in every ordinary case of radical operation. However, the cleaning out of the supraclavicular space *must be done* whenever the tumor has invaded the two upper quadrants of the breast, especially if it involves the skin, because the lymphatic vessels of this region enter into the supraclavicular glands across the anterior aspect of the clavicle." After the ablation, he examines the subclavian glands nearest the clavicle at the lower border of the subclavian vein by frozen section. If they show cancerous infiltration, he either divides the upper skin flap and continues the incision upward into the supraclavicular space, makes a second transverse cut above and parallel to the clavicle, or divides the clavicle temporarily near the spot where the subclavian vein dips beneath it and removes the glands with surrounding fat of the supraclavicular space contiguously with the subclavian plus axillary mass. If the clavicle is not divided, the tissue under it must be thoroughly cleaned out in conjunction with the supraclavicular. Pilcher dissects the supraclavicular region as the first step of the operation.

The Skin Incision. The incisions of Halstead, Warren, Meyer, Rodman, Jackson, Handley, Stewart, etc., are well known to surgeons. Both Pilcher and Meyer prefer a method which opens up the axillary space widely and seem to fear that the paraaxillary incisions afford imperfect access to the axilla.

Resection of the Axillary Vein. This "should unhesitatingly be carried out with the removal of the axillary glands when the latter are too closely attached to its wall to be removed with safety. Care must be taken to preserve the current in the cephalic vein, by placing the central ligature on the axillary vein, distal to its entrance into the subclavian."

Roentgen-ray Treatment after Operation. Both Meyer and Oliver¹²³ advise prolonged x-ray treatment after every operation. Levin¹²⁴ states that "the correct treatment of carcinoma of the breast, complicated with skeletal metastases, consists in the operative removal of the gross tumor mass, combined with radium and roentgen therapy. The radiations in a postoperative case of carcinoma of the breast should not be given only over the operative field and over the chest wall, which is the procedure generally adopted today, but should include, if not the whole skeleton, at least the spine and the heads of both femurs. Moreover, this combination of surgery and radiotherapy should be the method of choice in all advanced cases of carcinoma of the breast, even when there is as yet no evidence of skeletal metastases."

SKELETAL METASTASES IN CARCINOMA OF THE BREAST. Meyer makes the statement that, "preoperative and early postoperative exposure to the rays of the spinal column and femur, the places of predilection for bone metastasis seems advisable." This was inspired by the following from Levin:

"The radical operation for a malignant tumor means a complete eradication of all tumor tissue from the organism. It is patent that a radical operation in this sense of the word is impossible so long as a skeletal metastasis was diagnosed before the operation. Furthermore, Heurtaux has shown that ten years after a breast amputation only 12.32 per cent. remain free of the disease, and twenty years after the operation only 2.46 per cent. remain free. It would then seem that in the overwhelming majority of all the cases of carcinoma of the breast the best surgical methods of treatment do not completely eradicate the disease, but only prolong life. But, on the basis of the latter interpretation of the therapeutic results in carcinoma of the breast, skeletal metastases give a better prognosis than metastasis in other organs, since they are much slower in their development and may therefore be more readily controlled."

ANATOMICAL SUBSTITUTE FOR THE FEMALE BREAST. Bartlett,¹²⁵ with his usual originality, has devised an operation for the improvement of the cosmetic effect after complete subcutaneous removal of the breast in cases of chronic fibrocystic mastitis. A crescentic incision is made in the fold beneath the breast. The breast is lifted off the chest wall, all attachments being divided with the cautery and the pocket filled with a

¹²³ *Annals of Surgery*, 1917, lxx, 66.

¹²⁴ *Ibid.*, 326.

¹²⁵ *Ibid.*, 208.

gauze pack. Following the natural line of cleavage the dissection is continued above with the cautery until the breast is free. Hemostasis is made absolutely perfect. A mass of fat removed from the abdominal wall, thigh, or buttocks and 50 per cent. larger than the mass extirpated is stuffed into the breast defect and allowed to conform to its new surroundings. The breast wound is sutured with catgut and horse hair, without drainage.

CARCINOMA IN THE MALE BREAST. In the male child this lesion is very rare. Simmons,¹²⁶ in reporting a case, found only two others besides his own. The case reported occurred in a boy of thirteen years and followed a direct injury. It was a medullary adenocarcinoma. Simmons briefly reviews the literature. Rischbieth¹²⁷ reports another case occurring in a male, aged thirty-three years, where operation was followed by local recurrence in the skin and in the glands of the axilla. Roffo¹²⁸ reports his second case, occurring in a man, aged seventy years, who died without operation, but the growth was studied and found to be an extensive carcinoma of the tubular type.

¹²⁶ Journal of the American Medical Association, 1917, lxviii, 1899.

¹²⁷ Medical Journal, Australia, 1916, ii, 205.

¹²⁸ Presma Med., Argentina, 1916; abstract in Surgery, Gynecology and Obstetrics, February, 1917, p. 108.

SURGERY OF THE THORAX, EXCLUDING DISEASES OF THE BREAST.

By GEORGE P. MÜLLER, M.D.

WAR SURGERY OF THE CHEST.

THE World War has been productive of the most extraordinary developments in the technic of surgery that any decade has probably witnessed. No chapter is so interesting, even to the point of fascination, as that of the thoracic cavity, and particularly gunshot injuries of the lung and pleura.

Last year I devoted considerable space to this, and stated that it was impossible then to properly analyze the results and to decide upon the best method of treatment. This year steady progress toward enlightenment may be noted, and the most noticeable fact is the swing of the pendulum from extreme conservatism toward radicalism and then toward the perpendicular. That the lessons learned in the war can be applied to civil surgery is seen in a case of my own, in which a bullet was easily removed from the lung by the method of Duval, with perfect and rapid recovery of the patient. I propose to group the papers as nearly as possible in the order of the casualties—at the front, at the base, or at the home hospitals.

It is hardly possible at this time to determine the proportion of chest injuries as compared to other wounds, and it would profit but little if we could. Moynihan quotes Duval as having gathered from the records of the French Army a total of 3455 cases, with 688 deaths. Of greater moment is the classification of the type of wound and the state of the patient when received at the Evacuation Hospital, the first place where a major operation is performed.

Before considering the statistical evidence at present available it should be understood that the soldier wounded in the chest must run the gauntlet of shock, hemorrhage and infection, and that one after the other in addition to the repair of the wound, these conditions must be met. The views about shock are somewhat confusing, Herringham¹ states, "When patients are first admitted they are often collapsed from the drive down." Archibald and McLean,² in writing on shock at the Front, laid emphasis on the state of shock and the influence of cold and fatigue in its causation, but remarked that wounds of the chest and of the head very rarely presented the symptoms of shock. Hemorrhage will be manifested as external bleeding through an open wound, or as a hemo-

¹ Quarterly Journal of Medicine, 1916, x, 80.

² Annals of Surgery, 1917, lxvi, 280.

thorax, and in the former case the medical officer at the front will mostly have plugged the wound. It would seem to me that the gauze used for the tampon should be heavily impregnated with some antiseptic, and preferably an antiseptic ointment. Hemorrhage can usually be controlled, but from the time of the infliction of the wound until final recovery the evidence shows that infection is the foe to be fought and conquered if the man is to be saved and returned to duty.

Earlier but little was done for chest injuries until they were returned to the base hospital, but now it seems as though the man's future depends upon the judgment and care exercised at the front (British Casualty Clearing Station, etc.). Much of the discussion that follows is based upon the purely chest injuries, but it must be understood that very often there are complications which aggravate or even cause death exclusive of the wound to the lung. Herringham, during the summer of 1916, had 211 consecutive cases which died at the clearing station. "Three were due to septic infection of the external wounds by gas-forming organisms. The condition of the lungs was not unfavorable. Two were complicated by spinal injuries which caused paralysis and death within a few days. Five were complicated by severe abdominal injuries sufficient in themselves to cause death. In one, the entire stomach had been dragged into the pleural cavity, the man being too ill to examine carefully. In two others the spleen was torn right across, yet there was little hemorrhage. One case was apparently dying from abdominal injury, though shot in the chest also. Two cases died from lesions of the heart."

The character of the missile determines the prognosis to a great extent, as the following table from De Page and Janssen³ so well shows:

	Number.	Percentage of recoveries.	Percentage of deaths.
Rifle bullet wounds	182	82.4	17.6
Shrapnel bullet wounds	25	72.0	28.0
Shell wounds	140	60.0	40.0
Bayonet and other wounds	5	100.0	0.0
Unknown projectile wounds	2	0.0	100.0

The following table from Gask⁴ is even more illuminating.

	Number.	Mortality, per cent.
Rifle bullet, entry only	12	16.60
Rifle bullet, entry and exit	62	9.68
Shell fragment (including bombs):		
Entry only	158	20.90
Entry and exit	19	47.30
Shrapnel ball	11	9.09
Multiple shell wounds	28	21.43
Total	290	

Moynikhan quotes Rouvihois, who in 102 cases found that in 60 in which the missile was retained there were 27 deaths; in 26 of these the wound was caused by a shell fragment, in 1 case by rifle bullet. In 42

³ Bull. et m  m. Soc. de chir. de Paris, 1916, xlii, 2908.
⁴ British Medical Journal, 1917, ii, 784.

cases of perforating wounds there were 10 deaths; in 9 of these the wound was caused by shell and one by rifle bullet.

Non-penetrating Wounds. Comprising flesh wounds and tangential wounds of the thorax splintering the ribs, these wounds often become badly infected and affect the pleural cavity secondarily. The lung may be contused, and symptoms of hemoptysis, slight dulness, bronchial breathing and moist rales may be detected. If hemothorax occurs it will be small in amount, but frequently becomes infected. Pleurisy with effusion frequently occurs and usually becomes infected. It is important to remember that wounds apparently of the neck, arm, abdomen, etc., may wound the thoracic contents also and produce a hemothorax which is wrongly diagnosed as pneumonia. Murphy⁵ refers to pseudoperforating wounds of the thorax, involving the upper and lateral part of the chest or shoulder region, in which the thoracic cavity is not entered.

Penetrating Wounds. Consideration of this, the large and much more important group, leads us to consider the injuries inflicted on the chest wall, the lung and pleura on the side injured, the opposite lung, the mediastinal contents—heart, vessels, nerves—and associated injuries to the diaphragm and intra-abdominal organs.

THE CHEST WALL. Missiles, such as bullets, shrapnel balls, or very small fragments of shell, may simply drill a clear-cut penetrating or perforating wound with but little damage to the soft parts or bony structures of the thorax. On the other hand, in these, and especially in tangential, wounds enflaming the ribs, portions of bone, numerous splinters often, may be driven deep into the lungs or into the pleural cavity. Each bony sequestrum thus becomes a missile in itself and carries with it the ability to infect.

In more severe cases large, irregular fragments of explosive shell drive large holes or blow away portions of the chest with the production of the so-called open "sucking wounds." More rarely there may be a small entrance wound and a larger exit wound, "explosive in character."

The open chest wound causes intense distress and affords the portal for infection. The lacerated and contused soft parts and splintered ribs favor the continuance and spread of the infection.

THE LUNG. The wound in the lung varies from a simple perforation to a severe laceration. The bullet track is smooth, not always lacerated, and may be surrounded by blood infarction and consolidation. The bronchi seem to escape injury except in their smaller radicles. Moynihan states that the injury to the damaged lung is not confined to the path of the bullet and the parts immediately adjacent. There may be hemorrhage by *contre-coup* in the upper lobe if the lower is wounded, or in both if the projectile has passed near the base of the lung. Duval has shown that these may be recognized by the opacity seen on the radiograph, and the fresh adhesions met with at operation bear further witness.

HEMOTHORAX. This condition occurs in about 75 per cent. of the chest wounds and is the most important phenomena attending the so-called "closed" cases. Earlier in the war it was stated that it mostly

⁵ Wounds of the Thorax in War, 1915.

resulted from injury to the intercostal, mammary and azygos vessels, but on the authority of Bradford⁶ and others it is now believed to come from the lung tissue in the majority of cases. The reasons given are that (1) hemothorax is rarely seen unless the lung is involved, and (2) if a hemothorax is evacuated, recurrence of the bleeding is uncommon. Henry and Elliott,⁷ from a study of 100 fatal cases, also state that the source of the hemorrhage seemed, as a rule, to be the vessels in the lung. The early cessation of bleeding referred to by Bradford was mentioned earlier by Sauerbruch.⁸ He ascribed it to the low blood-pressure existing in the pulmonary system, the contraction of the collapsing lung and the peculiar hemostatic action of the wounded lung tissue. The behavior of the blood mass has also been commented upon. Elliott and Henry⁹ describe the sequence of events as follows:

"The wound made through the lung is generally a lacerated tract surrounded by a considerable amount of hemorrhagic extravasation. From these torn tissues and from the wound in the thoracic wall, where ribs are often splintered, fibrin ferment will be liberated in sufficient quantity to coagulate rapidly all the fibrinogen in the blood that is poured out from the wound track in the lung or chest wall. But the continued movements to which the effused blood is subjected within a breathing chest interfere with its coagulation and prevent its setting into a massive jelly. The fibrin is partly 'whipped' out and deposited on the pleural surfaces, irregular lumps of more complete blood clot may form like mush ice in the hemothorax, especially in the recesses of the pleural sac and along the vertebral groove at the back when the patient is recumbent. The rest of the defibrinated blood remains as a fluid, a fluid which resembles blood in depth of color more or less closely according to the number of red corpuscles that have escaped entanglement in the primary clot and are floating freely in it."

Davies¹⁰ does not accept this explanation, "as injury to one side of the chest is followed by diminution of movement of the corresponding lung and compression and immobilization of that organ as the hemorrhage increases." He believes it more probable that the escaping air bubbling from the wound in the lung produces the agitation necessary for the separation of the fibrin.

In some cases, as Bradford points out, defibrination does not occur and the blood clots the needle and prevents aspiration. Years ago Penzoldt pointed out that defibrinated blood was first obtained, and that later, with the onset of pleuritic irritation, leukocytic ferments appeared, only to disappear with the subsidence of the pleural irritation. A diluting serous exudate has been noted by several writers, and Bradford believes that a sudden increase in the amount of fluid is often strong clinical evidence of the presence of infection.

The usual signs of fluid in the chest are found, and, in addition, certain unusual phenomena must be looked for. The emphysematous state of

⁶ British Medical Journal, 1917, ii, 141.

⁷ Journal of Army Medical Corps, 1916, xxvii.

⁸ Beitr. z. klin. Chir., 1915, xvi, 489.

⁹ British Medical Journal, 1917, i, 413.

¹⁰ Lancet, 1916, i, 232.

the upper part of the lung results in a skodaic resonance above, often extending beyond the middle line. On the left side the high diaphragm may cause the stomach tympany to merge with the skodaic resonance. Tubular breathing, bronchophony or even whispered pectoriloquy may be heard. If there is much blood the heart is displaced, but in a few days may swing back because of (*a*) increasing collapse of the lung, (*b*) absorption of an early pneumothorax, (*c*) contralateral collapse. The roentgenogram is invaluable not only for the location of the missile and separated bone splinters, but also in locating the effusion, the state of the injured and the contralateral lung and the position of the diaphragm.

It is interesting to observe the variations in the size of the hemothorax, due in part to the extent of the laceration of the lung and in part to the degree of collapse. Wounds at the base seem to bleed less, probably because the deflation of the lung is sufficient to check the hemorrhage. A small hemorrhage and a high wound is usually accompanied by a massive deflation.

COLLAPSE OF THE LUNG. One of the most interesting phenomena attendant upon these gunshot injuries is this condition, of such infrequent occurrence in civil life as to cause considerable confusion during the early months of the war. The following is taken from Soltau and Alexander:

"The evidence of collapse varies according to the presence or absence of hemothorax. When there is no hemothorax the physical signs are as follows: Over the area of massive collapse there is complete dulness on percussion, with absence of breath sounds, vocal resonance and tactile vocal fremitus to a degree simulating fluid. Associated with this there is dyspnea, exaggerated on exertion and cyanosis. So close is the resemblance to fluid that on several occasions the exploring needle was used, without, however, finding any fluid. Further, the 'feel' to the finger is not that of fluid, and the cardiac displacement, if any, is toward and not away from the affected area, while the rapidity with which the signs may disappear is contrary to all experience of the rate of absorption of an effusion. When the deflation has not been so complete a condition of impaired resonance is found, associated with a tubularity of breath sounds and an increase of vocal resonance and tactile fremitus, and at times some crepitation. In such cases the question arises whether the condition is not that of pneumonic consolidation; in fact, the physical signs would naturally suggest the presence of a pneumonic patch. But the absence of the constitutional signs of a pneumonia and the rate of disappearance contra-indicate this. Moreover, the arch of the diaphragm is drawn up and the heart is displaced, neither of which conditions is produced by pneumonia. A further proof may be adduced, that in those cases in which we had time to estimate the chlorides in the urine there was no diminution in their quantity.

"In cases in which hemothorax is present the signs of collapse are obscured by those of fluid. But here the employment of x-rays shows that the arch of the diaphragm is raised, and therefore that the lung has shrunk to a greater degree than the pressure of the fluid could have accounted for. There must in such cases be some other cause than pressure to produce collapse of the lung. It is suggested that the process

is due to nerve influence, and that, owing to the injury which the terminals of the vagus in the wounded lung have sustained, a reflex action is set up. The reflex path would be from the terminals *via* the vagus to the respiratory center and thence by the phrenic nerve to the diaphragm, causing a diaphragmatic paralysis. This would explain the raising of the dome of the diaphragm of the injured side and the collapse of the lung. Other observers have noted cases in which the appearance of the diaphragm, as seen through a wound, suggested, from the lack of tone, a complete paralysis. The effect of such paralysis, with consequent collapse, would be to limit the effusion of both blood and of air into the pleural cavity."

Contralateral Collapse. That the collapse is more or less independent of the effusion is also evident by its frequent occurrence on the opposite side to that injured and the physical signs produced are erroneously attributed to the presence of contralateral pneumonia. The main distinguishing feature of the physical signs of pneumonia from those of massive collapse is the position of the heart's apex beat; in pneumonia there is no appreciable displacement, whereas in massive collapse the apex-beat is displaced *toward* the collapsed lung. In an ordinary hemothorax affecting one side it may be impossible to determine clinically whether physical signs on the opposite side are due to pneumonia or collapse, since, if the apex beat is found displaced, the displacement will necessarily be attributed to the presence of the fluid on the injured side. In such cases the diagnosis of contralateral collapse is largely an inference based on the absence of the clinical picture of pneumonia and on the rapidity with which the signs clear up, but in any given case there may be much doubt unless the diagnosis is confirmed by autopsy. Contralateral collapse of the lung has also been observed when the chest wall only was wounded; it has also been observed during operation on the chest and on autopsy. Soltau and Alexander¹¹ noted contralateral collapse in 17 per cent. of their cases. They suggest that the condition is due to a reflex action from the vagus terminals and the respiratory center, and thence by the phrenic to the diaphragm on the uninjured side, causing deflation up to total collapse. They do not believe that it is a compression condition in Groca's area because the area is too great, and it occurs when no fluid is demonstrable on the injured side.

Moynihan also comments upon the injury to the opposite lung. He states: "Such lesions are frequent; in the severer cases probably constant. They consist in small or large hemorrhages beneath the pleura or in the substance of the lung. These may be followed by filamentous or by firm adhesions between the visceral and parietal pleura. In a late stage the lung may present all the evidences of a bronchopneumonia at one point or in many. The increased activity imposed upon the lung by the restricted function of that which has been wounded no doubt renders it an easy prey to any malady. The presence of infected mucus in the trachea may lead to the inhalation of purulent or septic material into the uninjured lung. These conditions often improve very rapidly when

¹¹ Quarterly Journal of Medicine, 1917, x, 259.

the injured side is treated by aspiration of a large hemothorax or free drainage of an empyema."

PNEUMOTHORAX. "Pneumothorax is frequently associated with hemothorax in the early stages, but, as a rule, the absorption of air is rapid, and when the chest is closed a pneumothorax may disappear completely within twelve hours after the receipt of the wound.

"Occasionally the wound of the chest is of such a nature that some air may be sucked in by each inspiration and yet none escape on expiration (valve pneumothorax). The pneumothorax increases in size and the distress of the patient is very marked. Aspiration is useless and early operation, affording relief of pressure, followed by repair and closure of the chest wall, is the correct procedure." (Gask.) Soltau and Alexander¹² record 13 instances of 139 cases seen at the Base. They believe the air to be mainly intrapulmonary in character and due to injury of a considerable bronchus. Even with collapse of the lung, air is pumped into the pleural cavity until it is distended to a pressure equal to that of the highest intrabronchial respiratory wave, after which it does not tend to increase. Absorption rapidly takes place and the air may disappear within four or five days. They refer to rare cases of late pneumothorax, even as late as three weeks after the injury, due to a fistula from an old tuberculous focus or to expansion of the collapsed lung and reopening of the wound in the lung. Herringham¹³ reports a case of extreme pneumothorax of the type known for a long time as "pressure pneumothorax." (spannungspneumothorax).

SURGICAL EMPHYSEMA. "This is of frequent occurrence. Often it extends throughout the subcutaneous tissues, but does not require any special treatment, even when very extensive."

Substernal Emphysema. In addition to this general distribution it occurs in the extrapericardial fat and loose connective tissue of the anterior mediastinum. This "substernal emphysema" may give rise to physical signs which are especially noticeable when the emphysema is localized to the mediastinal tissues. Such signs are:

1. Absence of the precordial area of dulness on percussion.
2. Crepitations which occur with each heart beat and may more or less replace the heart sounds.
3. A precordial or pleuropericardial murmur may be present, and may render a differential diagnosis from pericarditis very difficult. As a rule the general condition of the patient and a moderate heart rate with the absence of pain will suggest that such a serious complication as pericarditis is not present.

"Apart from the above physical signs, the condition is of no significance, and usually disappears in a day or two." (Gask.)

"**PURULENT CAPILLARY BRONCHITIS** with thick, greenish-yellow, airless sputum is a dangerous complication; and it appears to develop with greater severity in infected cases that have been left for many days without drainage. It may be the exacerbation of a cold that was present before the man was wounded; and a history of exposure on the battle-

¹² Quarterly Journal of Medicine, 1917, x, 259.

¹³ Ibid., 1916, x, 80.

field after being wounded is often given by patients suffering from this complication. The bronchi of the injured lung are more extensively infected than those on the wounded side, where collapse and immobility tend to restrict the spread of infection along the air tubes. Autopsy reveals thick plugs of green pus rising up from the orifices of every cut bronchiole, and there is sometimes a bronchopneumonic spread of the infection into surrounding lung tissue." (Elliott and Henry.)

MORTALITY. It is difficult to estimate the exact mortality of chest wounds, partly owing to the incomplete returns from the aid posts and partly because of variations in the nature of the fighting. Pauchet¹⁴ says that 30 per cent. of the men with chest wounds died at the first-aid station from asphyxia or hemorrhage, 20 per cent. die in the ambulance and a few later at the interior hospitals. Elliott estimates the mortality in the field ambulance and casualty clearing station to be from 20 to 25 per cent., of which 10 to 15 per cent. are the early result of shock and hemorrhage, while 10 per cent. die from sepsis. The following are a few figures from recent literature, as seen at places corresponding to the evacuation hospital:

	Cases.	Deaths.
Herringham	211	22
De Page	360	99
Gatellier and Barbary	165	30
Roberts and Craig	199	54
Gask	365	76
Delore and Arnaud	71	25

This list gives a total of 1206 cases and 276 deaths—a mortality of 23 per cent.—corresponding closely to Elliott's estimation. Of course, many of the chest injuries are complicated by wounds of the abdomen, cranium, extremities, etc. If, for instance, in Gatellier and Barbary's¹⁵ list, we exclude the cases having multiple lesions, the mortality is reduced from 18.7 per cent. to 12.9 per cent. Gregoire (quoted by Moynihan and by Elliott) records 404 cases of chest wounds, pure and simple, with a death-rate of 11.7 per cent. These are the most favorable of any of the larger groups.

If we construct a schematic table, after the manner of Duval, it appears: That of 100 men wounded in the chest, about 20 per cent. will die at the aid posts, and 20 per cent. of the remainder succumb at the evacuation. This leaves 64 men to be evacuated. About 40 of these will be fit for duty in a few months, 8 probably being invalided. Sixteen will develop infection, and, as nearly 50 per cent. of these succumb and the remainder will take many months to recover, it is probable that no more than 45 or less than 40 of each 100 chest cases will be returned to the army.

The problem seems to be the attempt to save on the heavy mortality at the front and to prevent the inevitable infection, in the "open" cases and in the 25 per cent. of the closed cases, from assuming formidable proportions. The following quotation from Gask,¹⁶ and the tables appended are so illuminative that I quote them in full:

¹⁴ Presse méd., 1917, xxv, 233.

¹⁵ Bull. et mém. Soc. de chir. de Paris, 1917, xliii, 509.

¹⁶ British Medical Journal, 1917, ii, 781.

"1. If the complicating wounds are disregarded, the cases of death in pure chest wounds may be divided into three groups:

"(a) Deaths a few hours after admission to a casualty clearing station, due to very extensive and severe injuries which can seldom be aided surgically.

"(b) Deaths in a casualty clearing station after a few days. These are almost always due to sepsis of the pleural cavity and its contents.

"(c) Deaths at the base; sepsis again is the great factor. Similarly, prolonged illness is almost entirely due to sepsis. Therefore treatment should be directed toward the elimination of infection in chest wounds as in any other wound.

"2. The pleural cavity may become infected:

"(a) By the missile and portions of cloth carried in by it. Splinters of in-driven bones are a material factor both in causing and maintaining sepsis.

"(b) Through the wound of the chest wall; a wound that opens directly into the pleural cavity, and through which air is sucked, will always lead to infection. Further, a wound, even of moderate dimension through which air is not being aspirated, unless adequately dealt with may become septic in the course of one or two days, and, unless the thoracic cavity is sealed off, organisms may pass through into the pleural cavity, there they find the blood a convenient medium. This accounts for many cases which show septic changes only after four or five days.

"(c) From the wound of the lung in which foreign body, bone, or clothing may be retained." (Gask.)

TABLE OF RESULTS, SHOWING CASUALTY CLEARING STATION AND BASE MORTALITY. (GASK.)

	Number.	Per cent.
Total number of cases	365	
Total deaths	76	20.8
Deaths from complications:		
Chest and head	6	
Chest and abdomen	14	
Chest and spine	4	
Chest and heart	4	
Chest and large systemic vessels	2	
Chest and multiple wounds	14	
Chest and lethal gas	1	
Total	45	

If the above 45 deaths from complications are excluded, there remain 320 cases. Of these, 31 died (9.6 per cent.) of chest injuries.

	Number.	Per cent.
Causes of deaths from chest injuries:		
Shock and hemorrhage	19	
Sepsis	10	
Bronchitis	2	
Total	31	9.6

TABLE OF GENERAL RESULTS. (GASK.)

	Recovered.	Died.	Total.
Cases operated on	83	21 (20.20 per cent.)	104
Cases not operated on	206	55 (21.07 " ")	261
Total	289	76	365

Average stay in casualty clearing station, six and seven-tenths days.

TABLE OF OPERATION IN 365 CASES. (GASK.)

Operation.	Total	Subsequent empyema	Recovered.	Died.
Excision of wounds of parietes	36	—	34	2
Thoracotomy for repair of chest wall and lung with evacuation of hemothorax and closure of chest	24	4	15	9
Thoracotomy for removal of foreign body, repair of lung, evacuation of hemothorax, and closure of chest	16	2	13	3
Thoracotomy for infected hemothorax, and closure of chest	15	12	10	5
Abdominothoracic operations for repair of chest, replacement of viscera, suture of diaphragm	12	4	10	2
Laparotomy, with small wound of diaphragm not requiring suture	1	—	1	—
Aspirations	48	—	—	—
Total (excluding aspirations)	104	22	83	21

Total, 31 or 9.6 per cent.

The following table from Hayem¹⁷ may also be inserted here:

Nature of traumatism.	Number.	Operated within twenty-four hours.	Secondary operations	Indications for operation.	Deaths
Thorax closed, fistulous wound	24	5	..	Area of fracture very much splintered.	
Thorax closed, wound closed	19	9	..	Hemopyothorax 7 for large missile; 2 for missile menacing a large vessel	2
Thorax open (with large hemothorax)	9	8	..	Missile not tolerated (hemoptysis pyrexia).	6
Total	52	22	6		8 (16 per cent.)

TREATMENT. It is not easy to formulate the proper mode of procedure in chest cases from the available literature principally because of the

¹⁷ La Presse méd., 1917, xli, 627.

meager reports from those in front of the casualty station (evacuation hospital). The work of the latter is not checked up at the base nor in the home hospitals, and hence the same cases are not followed up to the end. It is impossible for me to state just what can be done in the field hospitals, but, insofar as I can make out, no major surgery on the thorax is done in front of the casualty station (evacuation hospital), and hence the description of the treatment will begin here. If the wound is large enough, it will probably be plugged at the front in the endeavor to check hemorrhage and asphyxia, which, according to Duval, is responsible for 20 per cent. of the deaths. Gask believes that open wounds should be sewn up at the advanced stations, thus giving better results than plugging and strapping.

Schwartz¹⁸ has given an excellent description of the condition of these men when first seen at the evacuation hospital (casualty station). The patient is brought in breathless and anxious, with an ensemble of more or less dramatic symptoms. There is dyspnea, rapid and superficial respiration, fluttering of the nasal ala, anxious expression, and the avoidance of every movement on the part of the patient that may increase the respiratory difficulty. The pulse is rapid and weak; the face pale or cyanosed and often covered with perspiration. Schwartz states that the wounded often arrive in an apparently alarming condition, although the recovery is rapid, and, on the other hand, some cases will be apparently benign and yet serious secondary complications ensue. The remainder of his paper is taken up with a description of the various points and treatment covered in the following pages.

Other important papers upon treatment at the front are those of Anderson,¹⁹ Roberts and Craig,²⁰ Elliott,²¹ Herringham,²² de Page and Janssen,²³ Hayem, Delore²⁴ and Arnaud,²⁵ and Gask.²⁶

From them I glean the following:

1. *Closed Wounds.* Caused by bullets, shrapnel balls, and small bits of high-explosive shell. As a general rule these cases do exceedingly well if treated expectantly, and aspirated or operated on only when occasion demands. Complications of hemothorax, pneumothorax, collapse and infection, must be met, and will be discussed later. Evacuation to the base can usually take place in from three to ten days, and, as a rule, the ultimate results are good. Of 199 cases, Roberts and Craig evacuated 108 to the base without operation. Sepsis is the important factor, and must be watched for daily, because, as Elliott has shown, while only 25 per cent. of the cases of hemothorax develop sepsis, the mortality is very high, reaching 50 per cent. Personally, I believe that a large hemothorax should be aspirated before the man is evacuated. If sepsis does develop early, I believe that a wide-open thoracotomy, after the method of Duval (or shall we say of Lilienthal), is preferable to simple drainage unless the patient is very ill. A "clean up" operation can be done early.

¹⁸ Paris méd., 1917, vii, 235.

²⁰ Ibid., 576.

²² Quarterly Journal of Medicine, 1916, x, 80.

²³ Bull. et mém. Soc. de chir. de Paris, 1916, xlii, 2908.

²⁴ Presse méd., 1917, lxi, 627.

²⁶ British Medical Journal, 1917, ii, 781.

¹⁹ British Medical Journal, 1917, ii, 575.

²¹ Lancet, 1917, ii, 371.

²⁵ Lyon chir., 1917, xiv, 280.

2. *Open Wounds.* (a) Those with air suction and blood leakage through open holes that are obviously too large for early closure. The patients are suffering from shock, usually from hemorrhage and from intense distress due to the open pneumothorax. A great, gaping cavity is present, with collapse of the lung unless it is held up by adhesions. In the past, as Elliott states, very few of these cases ever reached the base hospital, but recently better results have been obtained by radical operation. He states that Gregoire (reference not given) has operated upon 17 such cases, with only one operative death. But Anderson operated upon 58 cases, with 14 deaths (24 per cent.); and Roberts and Craig had a mortality of 33 per cent. in 51 cases operated. In small series, however, the mortality varies greatly. (b) Included in the class of open wounds are those tangential injuries of the chest inflating the ribs and driving portions of bone, etc., into the pleura and lung. There may be continued bleeding from the intercostal vessels, while the lung is generally mangled near the wound. (c) Also, those cases with large retained fragments of shell, almost inevitably infected and with a piece of rib or clothing carried in. (d) Entrance and exit bullet wounds, in which the exit wounds are explosive in character.

All of these groups may be considered as inviting early operation, as soon as the condition of the patient permits. "The patient should be put to bed and allowed to rest undisturbed for one or two hours to recover from shock. The only exception to this rule is when there is a large opening into the pleura through which air is sucked. In such cases the opening is immediately closed by temporary skin suture without anesthetic. This gives the patient immediate relief. A survey is then made of the whole patient, and all wounds examined; evidence of hemothorax, pneumothorax or collapse of lung is sought. Much may be gained by careful examination of the movements of the chest as a whole; the position of the heart is of the greatest importance. The whole body should be searched for complicating wounds, especially with regard to abdominal and spinal injury. An x-ray examination should be made." (Gask.)

The indications for early operation, according to Gask, are:

1. A ragged wound of the soft parts.
2. Compound fracture of ribs.
3. Bleeding from a parietal wound.
4. Suction of air into the pleural cavity.
5. Retention of a large foreign body in an accessible position.
6. Pain (often the result of in-driven splinters of rib scratching the lung with every respiratory movement.)
7. Rapidly increasing pneumothorax due to a valve-like opening into the pleural cavity which allows air to be sucked in and prevents its expulsion.

The contra-indications for operation, according to Gask, are:

1. Shock and collapse, such as would be contra-indications for any surgical procedure.
2. Small clean wounds, without evidence of serious intrathoracic injury.

3. Retention of a small foreign body in the lung or mediastinum. In our experience of early convalescence, the foreign body, if small, may be disregarded. We are not in a position to speak of the ultimate results.

4. Collapse of the opposite lung, as indicated by inspiratory retraction of the chest wall on the side opposite to the wound. In this condition an anesthetic and opening of the chest may be fatal.

Technic of Operation. Local anesthesia is to be preferred, if feasible, and not only should the local region be infiltrated but the intercostal nerves should be blocked posteriorly. In wounds of the upper part of the chest, the descending cervicals must be blocked, and, if the scapular region is involved, the suprascapular twigs may be anesthetized by injection of the dorsal scapular nerves all around the injured area (Roberts and Craig). If general anesthesia is used, ether by the open method is best, pressure apparatus not being necessary.

Without going into detail, it might be mentioned here that it is not the open chest that kills, it is the "flapping" of the heart and mediastinum. Means and Balboni²⁷ have recently shown that all the factors of respiration, gaseous exchange, CO₂ tension, etc., are essentially normal in persons with one lung collapsed.

The wound in the chest wall should be completely excised, including smashed ribs and soiled pleura. The cavity is then wiped free of blood and blood clots. Gask rolls the patient on his side to evacuate the blood. The lung is next palpated for the foreign body and it and any bits of clothing removed; the lung is trimmed, portions cut away, if necessary, and carefully sutured, or, if this is impossible, plugged with gauze smeared with antiseptic paste. Roberts and Craig sometimes found the foreign body "embedded in the opposite wall of the thorax or mediastinum, and the aperture of exit could be seen or felt; if necessary, a separate incision was made for its removal. An attempt was always made to excise the margins of the exit wound in the pleura, and to stitch them together. If this cannot be done, the tract should be rubbed with 'bipp' from the pleural side. In some cases the foreign body was found at the base, having gravitated there."

Duval would wipe out the entire cavity with ether, Gask uses eusol, Anderson has used flavine and brilliant green without untoward effects and "probably with advantage." If it is necessary to leave gauze packing in, a tube should also be inserted. It is interesting at this point to call attention to the way Robinson handles his gauze packing after excision of part of a lung for bronchiectasis. His paper is abstracted farther on. If at all possible, the cavity is closed without drainage—pleura, muscle, and skin, all carefully sutured. Even if only the skin can be brought together by flap methods something is gained. Roberts and Craig give two indications for drainage: (1) owing to the condition of the patient, and (2) if infection of the lung or pleura, as distinguished from the contents of the pleura, is definitely established. Even if a second thoracotomy becomes necessary by reason of empyema, the primary

²⁷ Journal of Experimental Medicine, 1916, xxiv, 671.

opening should be closed, but, as has been emphasized over and over again in this war and for injuries in all parts of the body, all of the lacerated devitalized tissue must be thoroughly removed. As Anderson says, "The whole aim of the operation is a prophylactic against sepsis, and to bring the patient as nearly as possible to the *status quo ante*. If it fails, a secondary drainage operation may be required later." Sometimes a rubber tissue drain may be used with advantage, after suture of the pleura, to take care of the widely infected muscle. If operation is done where the wound is small, the method of Duval (*vide infra*) should be followed, but it is not necessary to always choose the fourth rib. The radiograph is, of course, invaluable in these cases.

In the treatment of progressive emphysema, Moynihan states that multiple skin incisions will relieve the tissues already distended and crepitant. In a discussion by Hartmann²⁸ on mediastinal emphysema, he points out that multiple skin incisions are insufficient, and advises a suprasternal median incision followed by tearing of the pre- and pericardial tissues. In civil practice I have thought that trephining of the sternum would be a proper procedure.

Certain general treatment is advised by Roberts and Craig. They use morphine, coffee and glucose enemata, camphor, ether and olive oil hypodermically. Fowler's position, loose bandages and the calming of mental anxiety are mentioned. Creosote is useful to combat bronchopneumonia, and in the severe cases a polyvalent antistreptococcic serum was given routinely.

Pneumothorax. If grave embarrassment is caused by the pneumothorax, the air must be aspirated; a left pneumothorax is more likely to cause embarrassment than one on the right side, and should be carefully watched with a view to early puncture if required. Air in the chest, the result of infection with gas-producing organisms, is a grave complication requiring immediate operation; this will be further discussed later.

Sterile Hemothorax. The treatment of this complication seems fairly well established, and does not vary from that hitherto used in practice in civil surgery. Small effusions extending only to the lower angle of the scapula and half-way forward into the axilla are left alone. Elliott found that of 22 cases not aspirated, 20 returned to duty after a period averaging 3.4 months. Large effusions are aspirated when urgent dyspnea or marked displacement of the heart demand it; they should be aspirated routinely in three days (Elliott) or a week (Moynihan) at which time there is practically no danger of starting the hemorrhage afresh. Moynihan calls attention to the dense crippling adhesions which follow the failure to aspirate; and Bradford²⁹ insists that early and complete removal of every considerable accumulation of fluid is necessary to prevent the organization of the deposited fibrin while the lung is in a state of complete expansion. A second aspiration is rarely necessary, and will be found to yield but little fluid. Elliott reports that of 67 cases aspirated, 36 returned to duty on an average of 4.6 months from the time of injury—7 others were furloughed, 19 classed as "fair

²⁸ Bull et mém. Soc. de chir., 1917, p. 509.

²⁹ Lancet, 1916, i, 227.

results," and 5 were considered unfit for further duty. Most writers advocate "oxygen displacement" as the fluid is aspirated, in order to minimize the patient's distress. Bradford practises oxygen replacement in the following manner: "The apparatus consists of a glass container, with a capacity of about 25 c.c., having an opening at the top and bottom, and a third opening in the side, low down. From a cylinder which is connected to the lower opening, a stream of oxygen is allowed to flow through the container and escape at the upper opening. The lateral opening is connected by way of a filter to the needle which enters the patient's chest. Above the filter a three-way connection leads to the manometer; between this and the container is a tap which controls the admission of oxygen into the pleural cavity. As the aspiration proceeds and the manometer begins to register an increasing negative pressure, this control tap is opened and oxygen is sucked into the pleural cavity. The admission of oxygen can be regulated so that it corresponds exactly with the rate of aspiration of the fluid, maintaining a constant pressure. When all the fluid has been withdrawn, the intrapleural pressure can be left equal to that of the atmosphere, or at any degree of negative pressure that may be desired."

The treatment of large clotted hemothorax is radically different. A radical operation, after the method of Duval, should be performed and the clot detached. Opportunity is also afforded for removing any foreign body in the lung or pleural cavity. Elliott reports three such cases evacuated to England in the belief that the massive residuum of blood clot was sterile, but resection was necessary later for infection.

Septic Hemothorax. After recovery from the initial shock, hemorrhage and asphyxiating dyspnea, the patient with a chest wound has a 33 per cent. chance of developing infection. As has been said, 25 per cent. of the closed cases with hemothorax become infected. The mortality among the infected is enormous, and can only be reduced (1) by the meticulous treatment of the wound at the Front and at the casualty station and (2) by the prompt, almost instant, recognition of the infection whenever it appears. Elliott and Henry³⁰ well state that "life can be saved in at least four-fifths of the cases if the infected blood is promptly drained away. A day's delay in putting such treatment into force, when once the infection is well established, may mean death to the patient. The principal infecting organisms according to two sources are the following:

ELLIOTT AND HENRY.

Organisms found.	Number of cases.	Total deaths.	Total deaths from septic hemothorax of hopeless gravity and without other complications.
Pneumococcus, B. influenzae and M. tetragenus—that is, from respiratory tract . . .	17	4	2
Streptococcus and staphylococcus	38	11	4
Anaërobic gas bacilli (alone, 23; with other organisms, 19)	42	14	4
Diphtheroid bacillus, B. coli, etc. . . .	4	0	0
	<hr/> 101	<hr/> 29	<hr/> 10

³⁰ British Medical Journal, 1917, i, 413 and 448.

ROBERTS AND CRAIG.

	Per cent.
Streptococci were present in	72.7
B. aërogenes capsulatus was present in	54.5
Pneumococci were present in	36.3
Staphylococci were present in	27.2
B. influenzae were present in	27.2

In the majority a combination was found, in only four was a single type present. In addition B. tetragenus was found in 18.1 per cent., and a diphtheroid bacillus in 9.09 per cent.

Gask states that "a mixed infection is always severe, the anaërobic bacilli are among the most benign, and the streptococci—especially if hemolytic—are the most dangerous."

The signs of infection are the usual phenomena of rising temperature and increasing pulse rate, local pain and tenderness, dyspnea, jaundice, rapid increase in the size of the effusion and the results of needle puncture. Infection with gas bacilli is indicated by the sudden occurrence of pneumothorax several days after the receipt of the wound, cracked-pot percussion note, and patches of skodaic resonance over a hemothorax. Policard and Desplas³¹ believe that frequent "needling" will indicate the occurrence of infection before the clinical signs appear; if the number of neutrophils is increasing instead of diminishing about the third or fourth day, septic transformation of the hemothorax is imminent. Moynihan gives the following direction: "If the fluid closely resembles new port wine in color, it is free from infection; if it is clear and almost colorless, the amount of blood contained is small; most of the fluid is then the result of a pleuritic effusion. A turbid fluid like weak cocoa, or an effusion with any suspicion of offensiveness, indicates that infection is present, and that the condition is one to be treated as an empyema." Cox³² states that "Cases of hemothorax admitted in the base hospitals fall into three groups:

1. Those presenting evidence, clinical or bacteriological, of infection from the onset.
2. Those appearing at first to be sterile, which later, often about the tenth or fourteenth day after the wound, show evidence of infection.
3. Those which run a "sterile course" throughout. Some in this class, doubtless, are mildly infected, but clear up without surgical treatment.

Treatment of Infected Hemothorax. The manner of operating has not yet been definitely settled. As a rule the typical resection of a small piece of rib is practised, followed by drainage, and a few advocate the Carrel-Pakin plan after resection. Here and there a voice raises to venture the more radical operation of wide-open thoracotomy in order to wash out the clots, remove the foreign body, disinfect the cavity, and establish drainage by a stab puncture or small rib resection below. "This is only to bring the treatment of wounds of the lung into line with that practised elsewhere. The surgeon no longer allows infection to be well established in the wound; his aim is to attack by approved methods (the

³¹ Lyon chir., 1917, xiv, 240.³² Lancet, 1917, ii, 159.

free opening of the wound, the excision of all dead or contaminated tissue, the removal of all fragments of clothing, of all projectiles and of all foreign bodies) and then to secure the earliest possible closure of the wound which remains. No less an ideal and no less scrupulous a practice would guide him also in the treatment of wounds of the lung and pleura. The time has gone by when he can justly allow infection to become deeply ingrained before adopting those tardy, incomplete, and often ineffective methods with which he has been too long content." (Moynihan.) Gask believes that "provided the operation is done within a few days of the receipt of the wound, we believe that it is better to do a wider resection, by which means all clots can be removed and the pleural cavity washed out with eusol, and to close the chest in layers."

This method offers the following advantages:

1. The chest may remain closed, the organisms not developing.
2. The lung is allowed to expand, and adhesions may form which will prevent complete collapse, even if the pleural cavity is subsequently drained.
3. Respiratory distress is much less with the closed chest.

There is nothing new to add regarding the technic of rib resection; those who practise the proper methods in the treatment of empyema in civil practice will know how to handle these cases. The only addition is the use of the so-called Carrell-Dakin Method. After resection several small tubes are introduced to carry the hypochlorite solution, and a large one placed in the bottom to carry off the accumulated discharges. Fine wire may be placed in the small tubes to keep them rigid and assist in maintaining position. De Page and Tuffier³³ report that of 12 cases so treated, and where sterilization was effected and maintained for five or six days, the wound was freshened and sutured without troubling about the cavity beneath, and in 10 cases primary healing resulted.

Elliott and Henry are most optimistic about these drainage cases and it must be admitted that they are not comparable to the empyema seen in civil surgery. They state that "sooner or later the lung expands fully in practically all the cases, and the sinus closes without the need for any elaborate surgery. We have learned the after-histories in England and 30 of our cases, whose chests were drained for infection of a hemothorax, some for anaërobe infections, and others for streptococci, etc. The sinus became closed in the majority during the third or fourth month after the original wound, and some of the men were at once classified as fit for duty. In only 8 of the cases was the sinus open as late as the sixth month. There was only 1 case of chronic empyema cavity in which at the fourth month an Estlander operation was performed for its obliteration; and there were 2 cases in which small operations were needed for the drainage of a loculated collection of pus."

There are some very interesting observations upon the treatment appropriate to various clinical types in the paper by Elliott and Henry³⁴ but there is not sufficient space to present them, nor would they add any additional point to the discussion. The paper is well worth reading,

³³ Bull. et mém. Soc. de chir. de Paris, 1917, xliii, 790.

³⁴ Loc. cit.

however. The statistics of Elliott concerning the disability after sterile hemothorax were referred to. In comparison, he states that of 64 cases of infected hemothorax, 29 returned to duty on an average of 6.5 months; 15 were considered as a "fair result," and 20 as unfit. The size of the empyema and the type of infecting organism seemed to make no difference in the results.

Treatment of Retained Missile in Recovered Cases. Broadly speaking, the French surgeons are apt to be radical and remove all such retained projectiles, whereas the British only advise their removal if the foreign body is a large or irregular piece of shell. Elliott noted the presence of a projectile in 32.5 per cent. of 89 cases of sterile hemothorax with only one sufferer, and he died "in consequence of an operation for the removal of a harmless bullet." Rudolph³⁵ has collected the notes of patients in the Canadian hospitals in England, who have foreign bodies in the chest. He reports 50 cases, and they include all cases in which the foreign body lies deeper than the ribs, even though it may not be in the lung. Of these, 12 were invalided or discharged as permanently unfit. Two died as the result of operation. In one, the foreign body was surrounded by a large abscess, and the chest was opened and the abscess drained. Eleven days later the patient died from hemoptysis. The other case was operated on for a rifle bullet in the lung and died suddenly on the third day, apparently from pulmonary thrombosis. Thirty-six were fit for some military duty. He states that nearly all soldiers who have been shot in the chest, and in whom the missiles are still retained complain of some cough and shortness of breath and of some pain in the chest, but he cannot say that they complain any more than those in whom the missile has passed through and through.

He agrees with those surgeons who urge that all shell fragments, unless of small size should be removed within the first twenty-four hours, with the cleansing of the wound tract, suture of the lung, and evacuation of the blood clot from the pleural cavity. He does not advocate the removal of foreign bodies from the thorax at a later period when the patient has recovered. He concluded that when it has not been necessary for the surgeon at the front to operate immediately, it should not later be done unless some necessary indication exists, such as abscess.

Soltau and Alexander add that "it is a matter of military importance that the patient should not know anything of the presence of a foreign body, as it may be the pretext for future malingering.

On the other hand, Duval³⁶ states that he has yet to observe a really well-tolerated intrapulmonary foreign body. He finds that the cases fall into three groups:

"(a) A missile lodged in an inflamed area adherent *en masse* to the thorax, with or without a fistulous tract.

"(b) A missile lodged in healthy pulmonary tissue free from adhesions to the thorax, the diaphragm or the mediastinum.

"(c) An intermediate group; the missile lodged either in the soft normal lung, but the pleura contains old encysted sanguinary effusion or

³⁵ *Lancet*, 1917, ii, 709.

³⁶ *Rev. de chir.*, 1916, li, 365.

presents irregular adhesions to the parietal, thoracic or phrenic pleura, the remains of an absorbed traumatic effusion.

"In the first group removal of the intrapulmonary foreign body, the only means of relieving the pulmonary focus and of closing a fistula, is present. Spontaneous healing or a definite aseptic closure of the wound cannot be expected, and owing to the well-known tendency of late microbial infection in war wounds these cases present that danger."

Duval's Method. The typical operation is done in those cases where the missile is in a lung free from adhesions to the thorax, the diaphragm, or the mediastinum. When the lung is adherent as the result of organization of the exudate the adhesions can be freed with the finger or sometimes with the knife or scissors. Before operating Duval has a radiograph study made of the chest which is important not only in establishing the actual presence of the missile but for ascertaining the condition of the lung, the state of the parenchyma, the presence of thoracic adhesions, or the presence of old effusion.

After establishing the presence of the foreign body, its approximate location, especially its proximity to the anterior, posterior, or lateral walls is made with the aid of the screen and the Saissi compass. The exact location is made by means of a Hirtz compass. The calculation having been made, the compass is applied to the chest, and with the curved branch the point of the incision is decided upon, and is made according to the position of the missile dependent upon the existence of the missile and the shortest possible approach to the missile. The incision and resection of the rib follow and the parietal pleura is exposed. The compass is then again applied and the true intrapleural location and depth of the missile indicated. At the point indicated by the needle the lung is pierced by a needle and thread and thus fixed, so that when the pleura is opened and a pneumothorax created the site of the missile is not lost. The lung is then grasped with large forceps, drawn out of the thorax, palpated, incised, and the missile extracted. The pulmonary incision is sutured, the lung returned to the pleural cavity after careful drying, and the thoracic wall closed.

Ordinarily, this description taken from Duval's³⁷ paper would suffice for the purpose of this review, but it seems advisable this year to supplement it by the following quotation from Moynihan³⁸ in which the operation is so graphically described as to be perfectly plain to anyone who reads it. "The operation is performed in anesthesia induced by ether and oxygen. A preliminary injection of morphine and atropine is given about half an hour before the operation.

The patient lies flat on his back, with the arms to the side. A curved incision about 5 or 6 inches in length is made exactly along the line of the fourth rib. The fibers of the pectoralis major are split, and the pectoralis minor separated from the rib. There are many points of hemorrhage requiring a clip or a ligature. All must be carefully secured so that there is a perfectly dry field. The rib and the costal cartilage are exposed for a distance of not less than 5 inches. An incision is made

³⁷ Rev. de chir., 1916, li, 365.

³⁸ Surgery, Gynecology and Obstetrics, 1917, xxv, 605.

through the periosteum midway between the upper and lower borders, and this membrane is stripped from the rib on both surfaces. A Doyen curved raspatory is very useful for the purpose. In my earlier operations, I cut through the costal cartilage and then divided the rib with forceps, so that a length of 4 or 5 inches of the rib could be removed. In later operations I have freed the inner end of the rib after division of the cartilage, have passed a strip of gauze beneath it, and pulled it upward and outward. In this way the rib may be saved, and replaced at the end of the operation. This, however, is not a point of great importance, for when the periosteum is left, a new rib is formed very rapidly, and the chest wall soon becomes as firm as ever. Care is taken in excising the rib and in lifting it away not to wound the pleura, which must be separated widely from the ribs above and below, to the inner and the outer side of the wound. Unless this is done, accurate closure of the pleura later on, always difficult, will be impossible. A retractor is now placed in the wound to widen the interval between the ribs above and below. Any abdominal retractor will do; but the best instrument I have used is that invented for this special purpose by Tuffier. As wide a gap as possible is made, so that the whole hand can easily be passed into the chest.

The pleura is now incised along the line of the rib and air enters freely and at once into the pleural cavity. As a rule this causes no disturbance and does not alter the rate of the respirations or of the pulse.

The hand is now passed into the chest cavity. Adhesions of the lung to the parietal pleura may be encountered. These are sometimes very slender and easily broken through. At times they are tough and strong, and are with great difficulty severed. If they are numerous or thick and tough, bleeding may occur quite freely for a minute or two. With gentle pressure from a hot, moist swab, the oozing is soon checked. In a case where a projectile was in the base of the right lung posteriorly, the whole of the lower lobe and a great part of the upper lobe were most intimately adherent to the parietal pleura. The adhesions, however, separated in just the same way as adhesions within the abdomen separate by gentle pressure and stripping. Thoracic adhesions bleed, I think, far more freely than those encountered in the abdomen. When all are loosened, the collapsed lung lies free within the pleural cavity. It may now be seized with the fingers or with a special light form of clip and drawn up to the anterior wound, and, little by little, be coaxed out of the wound. It is surrounded as it appears by warm cloths soaked in normal saline solution. When a lobe of the lung is freely delivered, it is palpated from top to bottom. Any projectile imbedded in it is felt as a rule at once. Even little sequestra blown in from a rib may be recognized without any difficulty. These foreign bodies are as easily recognized as the particles of gritty sand in a new sponge. When the projectile is felt, the part of the lung containing it is made prominent, the lung tissue lying over it is incised, the metal removed, and the wound sutured. Deep stitches of catgut are passed through the lung substance, and with gentle tension act as a hemostatic.

If necessary, very fine catgut sutures may be used to secure the

accurate apposition of the pleural edges. If there is any bleeding from the collapsed lung, it is slight and easily controlled, but precision in suture is most desirable, for expansion of the lung will rapidly be secured when the operation is completed. If there are two or more particles of shrapnel or shell casing in the lung, they are all dealt with in the same way. I have once incised the hilum of the lung and stitched it up without difficulty. When the sutures are completed the lung is replaced, the cavity of the pleura most carefully dried and emptied and a gauze swab wet with ether wiped over the visceral pleura, and over any adhesion which may have been separated. The retractor is removed and the parietal pleura now stitched up. This is quite the most difficult part of the operation, indeed I have not been able to close the pleura accurately unless this membrane has been stripped up freely from the chest wall before being incised. The rib, if it has been turned back, is replaced, and fixed in position by a suture through the costal cartilage. The muscles are carefully sutured and the wound edges accurately approximated without drainage. The closure of the wound should be so carefully done as to seal the chest hermetically. When the dressing is applied, a two-way needle may be plunged into the chest, and the ether and air extracted therefrom. The lung then rapidly expands and faint breath sounds are heard at once. No shock follows this operation."

In his paper Duval mentions a number of instances where he was confronted with adhesions, but these were easily detached by cutting with a knife or scissors. In some cases where hemorrhage ensued, it was controlled by deep sutures followed by careful suturing of the surface ("peritonizing"). Desgouttes³⁹ reports that he has performed 52 extractions of projectiles in the lung by Duval's method, with 52 recoveries. He removed several missiles lodged near the lung hilum, but thinks that such removal is not advisable unless there are threatening symptoms. Gask⁴⁰ also followed the technic of Duval in his operations at the casualty clearing station. He seems to prefer resection of the fifth or sixth rib instead of the fourth. In the description of his operation, he states that the parietal pleura is incised and the retractor or rib-spreader is inserted. It will be noted that Moynihan introduced the rib-spreader before opening the pleura. I believe the method of Gask to be preferable, because the points of the rib-spreader are apt to lacerate the taut pleura.

The methods of Duval have also been described lately by Hayem;⁴¹ he has operated on 52 wounds of the chest at his ambulance since April, 1917. Operation was performed within twenty-four hours in penetrating wounds inflicted by a missile of a caliber not less than the size of a small nut (size?), or when, by the shape and location of the wound, a bloodvessel seemed likely to be involved. He also operated on the cases of large open wounds. In all other cases, non-intervention was the rule. He uses the same technic as described by Duval, except that he avoids resecting the cartilage owing to its failure to regenerate.

³⁹ Lyon chir., 1917, xiv, 355.

⁴⁰ British Medical Journal, 1917, ii, 781.

⁴¹ Presse méd., 1917, lxi, 627.

Mention must be made of a method for the removal of projectiles from the lung which is so different from that of Duval and so much simpler, but apparently fraught with such dangerous possibilities, and yet, according to the statements of its principal advocate, attended by practically no dangers whatever. It would serve no useful purpose at this time to discuss the developments of the method, but it probably originated with Mauclaire. Its principal advocate is Petit de la Villeon, and, without further comment, this year, I will present his method. It is curious that neither Moynihan nor Gask, in their articles published as late as the fall of 1917, mentioned this technic, because any method that allows the extraction of projectiles from the lungs of 200 patients with only one death is deserving of further investigation.

Villeon's Method. In his last article Villeon⁴² reports that he has done 97 operations by this method, and that an additional 103 have been done by other surgeons who are in accord with his method. Of these, all recovered except one, and this unsuccessful operation was due to errors in technic and has already been reported.⁴³ He believes that the operation is indicated in every case of foreign body in the lung except (1) those in the region of the hilum; (2) where the bullet is very large; (3) where there is an abscess about the missile. He states that the method gives the best results in missiles located deeply; located 8, 10, 12 and 14 cm. in the parenchyma. He particularizes the exact zone in which the operation is contra-indicated. It can be outlined on the posterior aspect of the thorax, and is bounded by the spinal column, fifth rib and the eighth rib.

Before operation, the surgeon and roentgenologist examine the patient in the upright position and with the screen. The two arms are elevated above the head to avoid the shadow of the humerus, and, taking the patient by the haunches, Villeon makes him perform rotation movements on the longitudinal axis, and in this way with preciseness the exact anatomical location of the bullet can be obtained.

The patient is anesthetized with ether or with chloroform and, one hour before operation, is given morphine. If the projectile is close to the heart or in the mediastinum, he gives caffeine or sparteine before operation. The patient is placed on a table carrying a frame which pivots so that the patient can be rotated on the longitudinal axis. The roentgen tube is beneath the table and projecting lead screens reach from the table to the floor to protect the operators. The arm is lighted with a 1000-candle-power lamp covered with ordinary red photographic paper, and Villeon states that the red-orange light, although intense, permits an immediate adaptation of the eyes to the fluorescent rays almost without an interval of darkness. The instruments consist merely of a knife, a long blunt forceps, and a needle. He has a special forceps which he recommends, but in the illustration it is practically the ordinary alligator forceps.

Two or three finger-breadths or more from the point of projection of the bullet, a slit 1 cm. long is made into the skin with a knife. The

⁴² Presse méd., 1917, xxv, 306.

⁴³ Ibid., 1916, xxiv, 300.

forceps is then pushed into the chest until it reaches the lung, care being taken so that the blades are constantly kept tightly closed. He next turns off the light for ten seconds; then the forceps are forced through the visceral pleura, and, always closed, pushed into the parenchyma beneath the missile which is then mobilized by touch and then seized and extracted by the forceps. The correction of direction is made by rotating the patient, and the secret of success in this point in technic is only obtained by practice, according to Villeon. In the typical case, it takes him from forty to fifty seconds to remove the bullet, and even in difficult cases the operation only takes from five to seven minutes. One stitch completely closes the buttonhole incision.

The immediate operative results are extraordinary. There is no shock and only slight hemoptysis during the first day or two. Temperature remains at the normal point and the patient is allowed to get up on the third day, and evacuated on the sixth or eighth day. In from four to six weeks he is able to return to the service. In 4 cases only was hemoptysis severe, and Villeon believes this was from sudden and stormy weakening from the anesthetic, and he now avoids this by the preoperative use of morphine. In 5 cases subcutaneous emphysema developed at the level of the thoracic wall, but it was limited and absorbed within forty-eight hours. He has never observed any post-operative pneumonia or any serous or purulent pleural reaction.

All of the operations were done about three weeks after the injury, and after the wound healed. Sometimes it was necessary to operate in the interval between two crises of pleural pneumonia. The greatest danger seems to be from the x-rays, and he cautions about the necessity for employing only hard rays and the use of short séances. The table is covered with aluminum to filter the soft rays. If proper screening is employed, gloves worn, and the hands kept away from the direct cone of light, the danger to the operator is minimized.

Abdominothoracic Injuries. "Injuries involving both the chest and abdomen are not infrequent, either as the result of a single or multiple missile. When a missile has traversed both chest and abdomen, the diaphragm is necessarily injured, and abdominal viscera may protrude into the pleural cavity. As efficient repair of the diaphragm can only be obtained from above, it is better in such cases to open the chest first, replace the abdominal contents, suture the diaphragm, deal with the chest as already indicated, and then, if there is evidence of injury to the hollow viscera, laparotomy may be performed.

The passage of a small missile through the diaphragm may not necessitate repair; in such a case, with evidence of injury to hollow viscera, the abdomen is afforded preferential treatment.

Similarly, with multiple injuries involving both chest and abdomen, it is probably better to deal with the abdominal injury first, but, when the patient's condition allows, the chest injury should be dealt with in addition, even if only a minimum can be done." (Gask.)

Delore and Arnaud⁴⁴ also state that by operating on the chest the dia-

⁴⁴ Lyon chir., 1917, xiv, 280.

phragm may be sutured and sometimes laparotomy avoided. At any rate, such a procedure prevents secondary complications from the pleura or lung. Patel and Papillon⁴⁵ report 25 cases in which the diaphragm was injured, and, of these, 14 had traversed the lung, 1 the liver, and 10 apparently did not injure any other organ. They state that projectiles are generally well tolerated in this region and operation should be done only when the missile lodges near the heart or the phrenic nerve. They usually operated by the subserous method, and only do the transpleural operation when the projectile is in the central section of the diaphragm. Gray⁴⁶ also states that in cases of multiple injuries involving the diaphragm and chest, one should suture the chest first and then deal with the diaphragm. Some writers, however, have urged the opposite, and would open the diaphragm first.

PROJECTILES IN THE MEDIASTINUM. Next year I will amplify this subject because there is not sufficient space to go into detail at this time. The principal writer on this subject is le Fort.⁴⁷ Binet and Massmonteil⁴⁸ and Patel and Papillon⁴⁹ should also be consulted. Mostly, le Fort operates by means of a costal flap, but in the discussion following his paper the criticism was freely expressed that the flap operation for thoracotomy was rarely needed. He approaches the mediastinum by the transpleural route. In addition, he mentions the following:

"1. Simple intercostal incisions with or without a limited resection of one rib (for foreign bodies easily reached).

"2. Anterolateral transpleural route with large resection of the sixth rib. This provides ample opening of the inferior mediastinal zone and of the diaphragm.

"3. Posterior transpleural route, which gives access, limited to the aorta, branchiocephalic trunk, etc.

"4. Extrapleural route. By this route access can be obtained to foreign bodies situated in front of the two first dorsal vertebrae."

Binet and Massmonteil operate by the anterior route when the projectile is above the third rib in front, and above the fifth spinous process behind. Below this zone they perform the lateral posterior incision. They agree with le Fort in resecting several ribs. Patel and Papillon perform an extrapleural operation for projectiles in the anterior mediastinum, the incision being made in the neck with or without the sternoclavicular resection or a sterno-chondro-costal resection, or a sub-sternal incision, depending upon the location. If these means do not sufficiently expose the field, they perform a transpleural operation, with resection of several ribs or a temporary flap. For deeply seated missiles of the posterior mediastinum, they perform an anterior transpleural operation, and state that the posterior method only gives access to the upper part of the mediastinum or possibly to the middle part.

Hayem prefers the anterior method, and, after opening the chest, depresses the lung and manipulates the hilum. The missile being palpated with the fingers, the site is exposed with a "camula sound"

⁴⁵ Lyon chir., xiv, 394.

⁴⁶ British Medical Journal, 1917, ii, 580.

⁴⁷ Bull. et mém. Soc. de chir. de Paris, 1917, xliii, 26.

⁴⁸ Ibid., p. 78.

⁴⁹ Lyon chir., 1917, xiv, 413.

and removed with great care, especially if it is rough and irregular, in order to avoid rupturing the vessel walls. It is also possible by this method to remove a foreign body from the pericardium, as this structure may be incised posterior to the phrenic nerve and easily sutured after removal of the missile.

Empyema of the Thorax. In *PROGRESSIVE MEDICINE* for March, 1916, I presented the paper written by Lilienthal describing a radical change in the procedure for the treatment of acute empyema of the thorax. The keynote was full and complete exploration through a widely spread, long, intercostal incision, without resection of the ribs. This was termed major thoracotomy. In another contribution, Lilienthal⁵⁰ reports the results of 100 cases operated on by this method. All patients suffering from empyema of the thorax and not previously treated surgically were operated upon regardless of the prognosis and regardless of the source of the pus. The following table summarizes the result:

	Minor thoracotomy.		Major thoracotomy.		Resection for encapsulated empyema.		Resection and drainage, old method (minor thoracotomy).		Miscellaneous.	
	Children.	Adults.	Children.	Adults.	Children.	Adults.	Children.	Adults.	Children.	Adults.
Number	31	7	21	23	6	1	6	1	0	4
Dead	6	1	4	8	0	0	1	0	0	3
Ages of those who died	1, 1½, 2, 3, 4, 4½	62	1, 2, 3½, 4	16, 24, 25, 35, 40, 43, 52, 55			1½			25, 27, 33
Percentage mortality	19.3	14.3	19	34.7	0	0				
Total	38		44		7					
Mortality rate	18.4 per cent.		27.2 per cent.		0					

Total number of cases of empyema of all varieties which were operated upon primarily in Dr. Lilienthal's service in Mt. Sinai Hospital, March 25, 1914, to March 25, 1917, regardless of the source of the intrapleural pus 100
 Total number of deaths from whatever cause 23
 Percentage of mortality 23
 Children under twelve years 64
 Adults 36

The above statistics include one patient with pyemia, perforated metastatic lung abscess and suppurating osteomyelitis of the bones about the knee-joint, who died following an amputation of the thigh; 2 fatal cases of pyemic abscesses of the liver with perforation into the chest; 1 fatal case of tuberculosis of the lung with perforating bronchiectasis. Deducting these, instead of 100 cases with 23 deaths, there would be 95 cases with 18 deaths, or 18.9 per cent. mortality instead of 23 per cent. shown in the table, but then, Lilienthal is "not in sympathy with the sport of juggling with statistics."

Comparing the mortality with the 299 cases reported by Wilensky⁵¹ from the same hospital, there is a reduction of 5 per cent.; the patients who recovered remained in the hospital an average of about thirty-seven days, a gain of one week over past records; whereas in the past years thoracoplastics were performed in probably 15 per cent. of the cases;

⁵⁰ *Annals of Surgery*, 1917, lxvi, 290.

⁵¹ *Surgery, Gynecology and Obstetrics*, 1915,

during the period from March, 1914, to March, 1917, there was not a single thoracoplastic collapse operation. There were a number of revisions, secondary and even tertiary, but eventually all the patients referred to in the table and not in the mortality list went home with symmetrical chests and fully expanded lungs.

No unnecessary risk was taken, because, whenever the patient's condition on admission was considered critical, the relief of minor thoracotomy was given, and, in a few days to two or three weeks later, if it became evident that something more had to be done, the radical operation was undertaken. Lilienthal lays stress upon the importance of preliminary roentgenography, and he depends upon this clinical history and the physical signs for the diagnosis, avoiding exploratory puncture of the thorax until just before the operation.

BRONCHIECTASIS.

Resection of the Lung. Bronchiectasis has long defied treatment and it is only recently that it has seemed possible that it may be cured by a surgical operation. To those unfamiliar with the subject, pneumotomy, with drainage of the cavity, had seemed to be the operation of choice, but experience has shown that the drainage operation is not effective, but the result is a failure and the condition of the patient made worse. It would serve no useful purpose to go over the etiology and diagnosis of bronchiectasis, and I will confine my remarks entirely to the subject of pneumectomy, and particularly its technic as practised by Robinson.⁵² To quote from Robinson, "there is but one curative treatment of true bronchiectasis—excision of the diseased lung tissue. The group of suitable cases, however, is small. A young adult with a basal process confined to one lower lobe, with profuse sputum, offensive but not fetid; with slight, if any, rise in temperature; with loss of weight but without emaciation; with a normal heart and properly functioning kidneys—this is the type of individual in whom lung resection, properly executed, is attended with good chance of cure. It matters little whether the disease is of the cylindrical, ampullary, or large cavity type, provided the general condition of the individual is as specified. Not more than one in every ten cases of bronchiectasis entering a hospital clinic represents this favorable type. The remaining nine are unsuitable; one may be a rachitic child with low resistance; several may have extensive involvement of both lungs; another, a local process in an inaccessible part of the upper lobe; another, nephritis; and the remainder may be poor surgical risks because of extensive peribronchial disease, secondary infection, and gross cavitation."

Robinson has now operated upon 7 cases, with 3 deaths, a mortality of 43 per cent., and, in the discussion, Lilienthal,⁵³ stated that he had performed 9 lung resections, with 4 deaths, a mortality of 45 per cent.

⁵² *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 194; *Journal of the American Medical Association*, 1917, lxix, 355.

⁵³ *Journal of the American Medical Association*, 1917, lxix, 357.

Robinson's technic is as follows: Neither differential pressure nor intratracheal insufflation anesthesia was used or necessary. On three occasions he introduced the tracheal tube and applied suction to it intermittently with a motor-driven aspirating outfit. "The incision is crescentic, with its convexity downward, starting at the fifth rib two



FIG. 6.—Lower lobe excision in two stages: *a*, crescentic incision; *b*, stage 1, thoracic window made. Exposure of parietal pleura favors adhesion and anchorage of the upper lobe.

inches from the vertebral column, crossing the eighth rib in the scapular line, and terminating at the level of the sixth rib in the mammary line.

The skin and fat are dissected upward from the muscle for an inch. Vessels are clamped and tied. The latissimus muscle fibers are separated vertically to admit long-bladed curved muscle clamps, which are applied

in series above and below in the direction of the sternum and again toward the vertebral end of the wound. The muscle fibers are then divided transversely between the clamps.

The field thus exposed should permit the subperiosteal resection of the seventh, eighth, and ninth ribs from their angles to the anterior axillary line. The intercostal bundles are then ligated and removed. The skin and muscle flap is then replaced. The wound is closed tight."

At this first operation Robinson provided a thoracic window ready to open and also has provided for the collapse of the chest wall necessary for the subsequent obliteration of the space left after amputation of the lower lobe. At the same time something has been learned of the individual's resistance to operation, of his tolerance to anesthesia, and of the amount of flooding by tracheal secretion in his particular case. An interval of a week is allowed to elapse, during which time the patient is treated by periodic posture to aid in drainage, but is placed in the sitting position in the intervals. A compression pad and supporting straps are kept tight over the wound. At the end of a week, if all trace of shock has disappeared, the temperature nearly normal, and the power of expelling sputum restored, the patient is discharged.

Second stage. The skin stitches are removed, the scapula and flaps retracted, and the pleura again inspected. It will be found that in the upper part of the exposed field there are new pleural adhesions anchoring the upper lobe. The lower lobe is still adherent at various places, now somewhat retracted and purple red in color. The pleura is opened wide at any point whether adherent or not. There will be no particular change in respiration or pulse (Fig. 6).

The separating of adhesions necessary to deliver the lower lobe is generally irksome. It is the difficult part of the operation. The lower lobe is generally bound to the diaphragm and costodiaphragmatic angle by tough, unyielding bands which may not yield under digital pressure. If undue force is used in stripping, the lung surface will tear before the adhesion gives way. Some of these should be cut. It is well, therefore, to free the lobe first from all except its diaphragmatic attachments, so that, if bleeding occurs during the separation of the latter, a clamp may be applied temporarily in the region of the lobe hilum. The interlobar fissure does not always provide for a simple cleavage, nor is it advisable to employ too much force in this region lest the light adhesions be parted, which by now should be holding the upper or middle lobes to the parietes. The pericardial surface is least troublesome of all. *To stop the operation at the middle of the second stage and to defer the completion of adhesion-stripping and the amputation to a third stage is a conservative measure not to be regretted, and one which, in difficult cases, may save the patient from undue hemorrhage, shock, and carbon-dioxide poisoning.*

If there has been no occasion to close the second stage prior to the complete delivery of the lower lobe, amputation is promptly performed as follows: A long curved clamp is applied to the root and closed to the last notch. The lobe is then amputated at least a half-inch distal to the clamp. The veins, arteries and bronchi are then picked up separately and ligated with No. 2 chromic catgut. A mass ligature of kangaroo

tendon or braided silk is then placed just proximal to the clamp, and tied as the clamp is slowly released, the ligature being guided into the crushed area evacuated by the clamp. Not infrequently two clamps are necessary safely to include the whole stump. It is apparently an equally satisfactory method to leave the root clamps *in situ* and to remove them on the seventh day (Fig. 7).

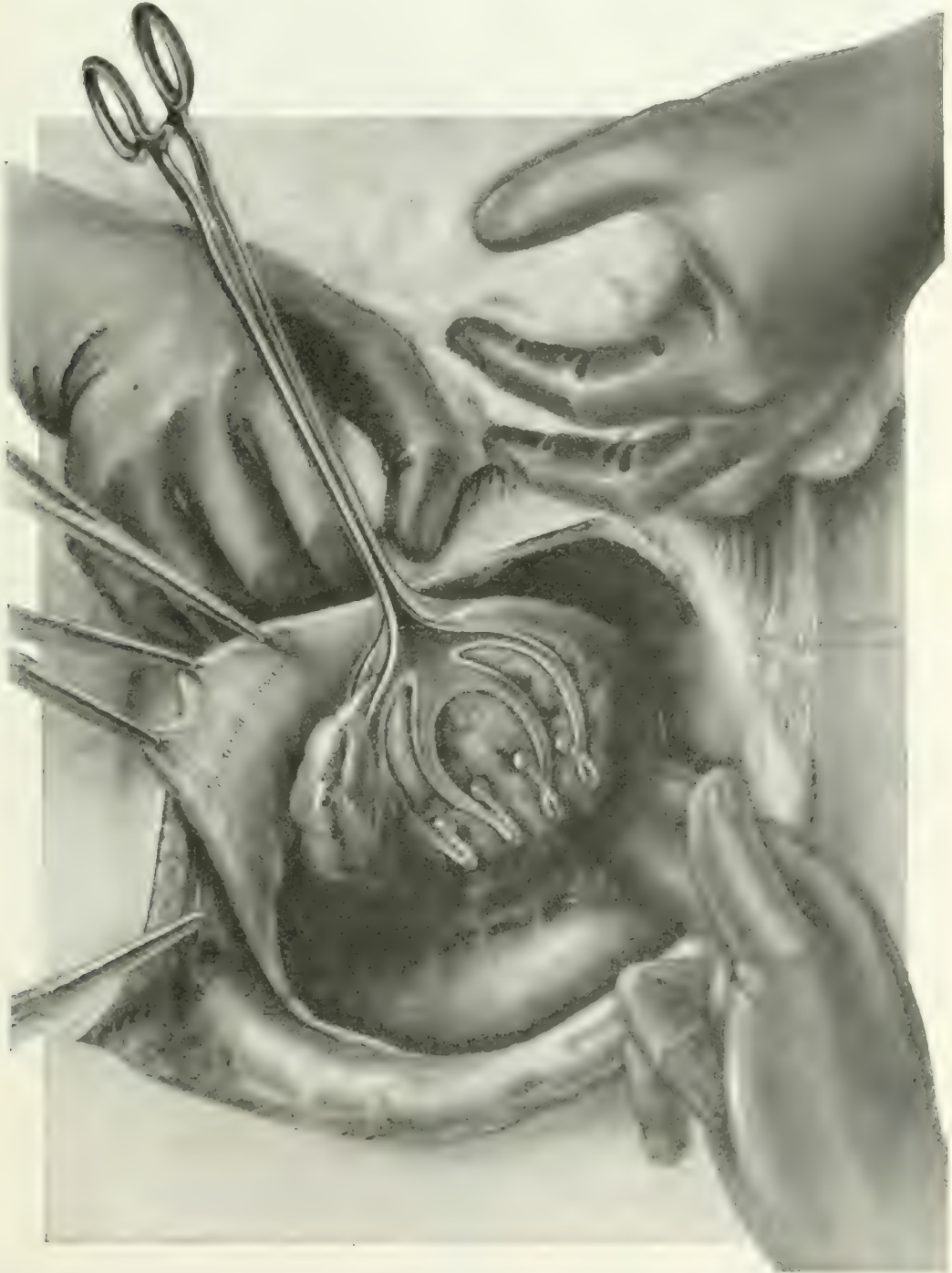


FIG. 7.—Lower lobe excision. Stage 2, thoracic window opened. Shrunken lower lobe is freed from its tenacious diaphragmatic adhesions.

Both of these methods of amputation result invariably in subsequent leakage of the bronchial stump. The portion distal to the mass ligature or clamps sloughs away within a week or ten days, leaving one, two or three fistulous openings of small caliber. Experience will prove whether

or not it is expedient to attempt any special technic for hermetically closing the bronchus at the time of amputation. The bronchus at the

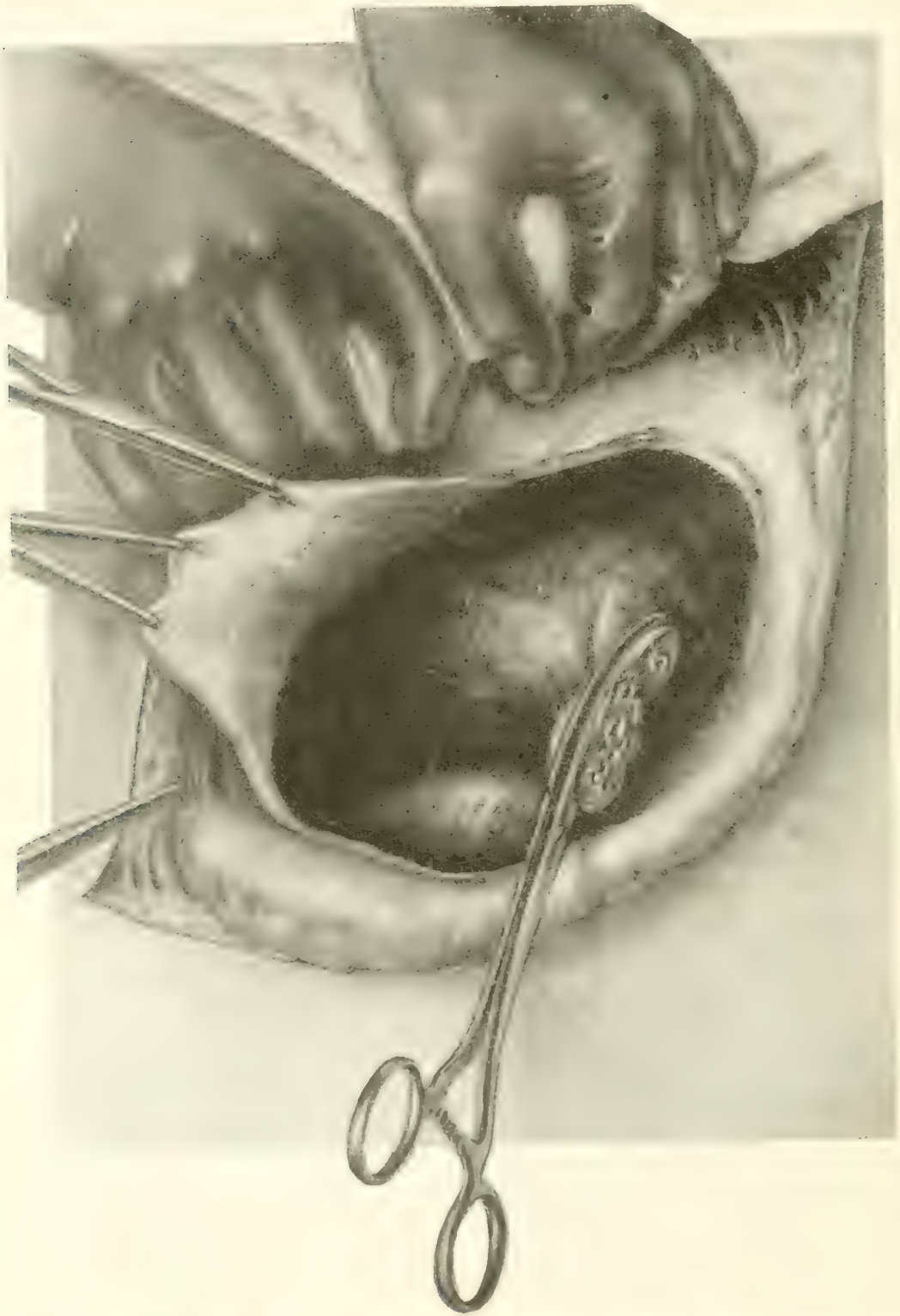


FIG. 8.—Lower lobe excision. Stage 2 (continued), amputation of lobe. Clamp to be substituted by mass ligature. Additional ligatures to vessels in stump. Two clamps may be applied and left *in situ* without ligation.

point of division is generally dilated; its walls are thick, tough, and unyielding. It is probably not amenable to such treatment as invagination and end-suturing, which has been successful in normal animals.

If treatment of this kind were attempted, it would necessitate the isolation of the bronchus from the vessels in the hilum, the individual double ligation of the vessels before their division, and the crushing, division, cauterization, invagination, and suturing of the bronchus. Neither the clamp nor mass ligation could be employed. In the present period of undeveloped surgery of the diseased lung, it would seem more proper not to sacrifice time at the end of a critical operation by any finesse in the treatment of the bronchial stump, which, in its pathological condition, would stubbornly resist any technic of closure.

The minute fistulas consequent on the clamp and mass ligature technic in no way complicate the convalescence. The pleural space is rapidly obliterated, the fistulas remaining the only unhealed points in the wound. By local plastic surgery under local anesthesia the fistulas are closed later by the superimposing of a skin-and-fat flap.

The after-treatment is now simplified because of the absence of bronchial secretion, and Robinson believes that the sudden freedom of the patient from a cough of perhaps ten years' duration is a stimulus mentally and a boon physically. Removal of the pack is begun at the end of four days, and it should never be pulled away if adherent, but, on the contrary, allowed to remain until the fragments have sloughed away. It is necessary to repack the persisting pleural space completely to prevent pocketing. At no time during the convalescence should drainage tubes be substituted for gauze, nor should irrigation be practised. Finally, obliteration of the pleural space remaining usually occurs within four months.

Optional Intermediate Stage. If, in the course of separating the lower lobe from its adhesions during the usual second stage of lobectomy, indications arise from closing the operation before amputation, the whole procedure is converted into one of three stages. A gauze pack (6 inches wide; 8 thicknesses) is then "fed" into the unoccupied portions of the pleural cavity in such manner that the partly delivered lobe may not adhere again to the structures from which it has been separated. Care should be taken that the entire costodiaphragmatic angle is packed—that the pericardial surface is protected; that loops of the pack are interposed between the lobe and the costal pleura; lastly, that any pleural pocket produced by retraction of the upper lobe be likewise filled with gauze. In placing the pack, care is taken to fill all the spaces and to do so with moderate pressure only. If a pleural area is overlooked, adhesion bands may form subsequently and encapsulate a local empyema (Cases 2 and 5).

The lower lobe, shrunken by disease, is now also partially collapsed. It is surrounded and "jacked up" by the gauze pack in such fashion that there is some tension at its root. This adds stability to the mediastinum and also prevents undue retraction of the neighboring lobe.

The cavity, filled with gauze, is closed tight without drainage. The flap is sutured in place with interrupted, figure-of-eight, silkworm-gut sutures, taking in skin and muscle. A running horse-hair stitch is added to hermetically close the wound. The dressing is applied with a graded compression pad and "adhesive," as after the first stage of the operation.

The gauze packing and the tight closure of the wound are important factors during the first two days of convalescence. They serve as a buttress to the healthy lung lobes as well as to the bronchiectatic lobe. Coughing is rendered effective in expelling secretions. The pack takes up any infection which may have escaped from the diseased lobe during its liberation and hastens the anchoring of the upper and middle lobes in their new position by adhesion."

In a few days the onset of hydrothorax necessitates the removal of the packing. This should be gradually effected in two sittings, and then replaced in such a way that either unoccupied portion of the pleural cavity is filled with gauze. In spite of the fact that the discharge becomes purulent and resembles an empyema cavity, the space is rapidly filled by elevation of the diaphragm, by partial mobilization of the mediastinum, and by the growth of granulation tissue. Robinson believes that if the intermediate stage is practised, the third, or amputation, stage should not be postponed for more than two or three weeks.

Intercostal Lobectomy. This is the method practised by Lilienthal, and, as Robinson says, it has distinct technical advantages, although when performed in one stage an undue risk of life is incurred. As a rule endotracheal insufflation anesthesia, alternating at opportune moments with tracheobronchial aspiration, is indicated.

"The incision follows the seventh or eighth intercostal spaces from the rib angles to the costochondral articulation. The skin and fat are dissected away from the muscles for an inch above and below the incision. The muscles are divided the length of the incision; the vessels ligated. Both layers of intercostal muscles are cut at a distance of 2 inches at the center of the wound, the parietal pleura being thus exposed. The pleura is then nicked, air being allowed to enter slowly as the opening is closed intermittently with the finger. As respiration adjusts itself to the open pneumothorax, the intercostal muscles and pleura are divided to the ends of the wound, care being taken that the cut is made midway between the ribs to avoid injury to the intercostal vessels."

The rib spreader is then introduced, and, if the separation is not sufficient, the seventh or even the eighth rib may be divided at the anterior end of the incision. The lower lobe is then separated from the adjoining lobe, the diaphragm, the costal pleura, and the pericardium.

At this stage in the operation, Robinson suggests that if the patient's condition is questionable, with cyanosis and poor pulse, the rib-spreader should be removed, the ribs pressed together, and the skin edges apposed with clamps or towel clips. If such temporary closure fails to relieve the patient, it may be well to close the wound and postpone amputation, but, if the patient's condition warrants proceeding, the lobe is ligated and amputation done in the manner previously described. Robinson closes the wound by pericostal sutures of strong silk, after the method of Sauerbruch.

If no apparatus is being used, the wound is held open by a clamp, and the last suture hastily drawn taut and tied at the end of an expiratory movement. If endotracheal insufflation is in action, the outflow of air around the tube is obstructed momentarily at the end of respiration by

bilateral compression of the trachea. Finally, the muscles and skin are carefully closed to prevent leaking.

Although the bronchial stump is a source of infection, the suction of the chest wall is imperative during the first twenty-four hours of convalescence. To prevent against the infection, however, Robinson makes a half-inch incision in the posterior axillary line overlying the intercostal space which the intrathoracic guiding of the finger indicates as corresponding to the very bottom of the pleural space. An opening is then made from the incision through all the chest-wall tissues into the cavity. Through this a quarter-inch rubber tube is passed which projects 2 inches into the space. Two silkworm-gut stitches are taken to approximate the skin closely about the tube *which is corked or doubled over and tied or clamped*. The intercostal thoracic wound is then closed as described. A spigot, as it were, is thus constructed which may be opened, with suction applied as occasion arises. If the lung collapse is later extreme, the intrathoracic pressure may be rendered negative by sucking the pleural air out by this tube; simultaneously such fluid as may be present will be withdrawn.

If untoward symptoms develop a few hours after operation, effective restoratives are often sought in vain. The combined circulatory and respiratory embarrassments are woefully unresponsive to stimulation. For labored breathing, a sitting posture, fresh air, and oxygen are helpful. For labored heart action, irregular and compressible pulse and low blood-pressure, caffeine, camphorated oil, digitalis, proctoclysis, and hypodermoclysis should be administered.

INFECTIOUS DISEASES, INCLUDING ACUTE RHEUMATISM, CROUPOUS PNEUMONIA, AND INFLUENZA.

BY JOHN RUHRÄH, M.D.

THE past year has brought forth a number of new contributions to our knowledge of the infectious diseases, and a great many studies that, while containing nothing definitely new, have had much of interest in them. Naturally, the war has curtailed more than ever the number of contributions, and a very considerable number of the articles that have appeared deal with problems relating to diseases incurred in trench warfare or in the large camps. Among these may be mentioned trench fever, which has been reported by a number of observers, and what appears to be the causal organism described by Dimond. There are also trench foot, and trench shin, and epidemic nephritis has appeared in some of the armies. In addition to these, Vincent's angina, ordinarily a rare affection, has been found to be common in the troops living under adverse circumstances and has gained for itself the name of trench mouth. Plotz has announced the cultivation of the organism of relapsing fever directly from the patient's blood, and Tunnicliff has grown an organism from the blood of measles patients which she believes to be the cause of that disease. Nichols has suggested the use of the alkaline treatment of gall-bladder typhoid carriers, and Weil's disease has come in for a very considerable amount of study; more evidence has been brought forward that the disease is transmitted by rats, and the organism has been studied by a number of different observers. There have been a very large number of contributions on poliomyelitis, as was to be expected, resulting as the aftermath of the epidemic of 1916. Many of these are of great importance and will be far-reaching in their influence. The mode of transmission of the disease, however, remains a mystery.

Of recent years pneumonia has been investigated by numerous observers, chiefly Cole and his associates at the Rockefeller Institute, and I have given somewhat in detail the recent observations that were made on the pneumococcus serum and the newer chemical methods of treating the disease, particularly by ethylhydrocuprein. Chagas has published two important studies on the American trypanosome, which causes a formidable disease, particularly of children, in Brazil. The fact that his publication is in Portuguese has kept it from having the wide publicity that it deserves. Perhaps the most important contribution during the past year is the study made by Bull and Pritchett on the production of a serum for the cure of infections by the *Bacillus*

welchii. If this serum works out as well practically as it has in the laboratory, it will take its place alongside of the diphtheria and tetanus antitoxins and will henceforth be regarded as one of the great medical achievements.

The Rockefeller Foundation. It is impossible to pass over, without a word of comment, the Annual Report for 1916, which reveals the extent of the splendid work that is being done in carrying scientific medicine to the far ends of the earth. In addition to the war relief work and activities in China, particularly in reference to the hookworm disease, the work of the International Health Board has expanded rapidly.

The Yellow Fever Commission of this Board, after a study of the subject in South America, believes that it is feasible to eradicate the disease and that the present is an opportune time for beginning the work, as war conditions have greatly reduced immigration into the countries in which yellow fever prevails, and this lack of human material for the disease to "feed upon" has resulted in its being at a low ebb.

Other activities are those in connection with the problem of the great increase in tuberculosis in France, and a number of interesting studies on the prevalence of the hookworm and the possibility of its eradication in the Federated Malay States and various other island countries, as well as in the parts of the world where the disease is known to be particularly prevalent. Studies have also been carried on regarding the prevention of malaria. Three experiments have been made in Arkansas, two in Lake Village and one at Crossett. At Lake Village 103 homes were selected from plantations in the immediate vicinity of the town and divided into three groups: (1) Those in which the control was based on screening; (2) those based on the issuance of prophylactic doses of quinine; (3) a combination of both. The results of these observations are awaited with unusual interest. At Crossett the study was largely concerned with drainage, regarding the removal of accumulated vegetation and the systematic use of oil and other substances. The remarkable decrease in malaria resulting from these measures has resulted in the community being interested to such a degree that they have taken over the work for themselves.

Another very important advance is the foundation at Baltimore of a school of hygiene and public health. The work of public health agencies in this country has heretofore been greatly handicapped by the fact that there was no school prepared to give adequate training in public health. I have repeatedly, in these pages, called attention to the fact that the best results in preventive medicine cannot be obtained by employing part-time officers, and especially those who have not sufficient knowledge of the subject in hand. At present most of the health departments concern themselves very largely with the presence of disease after it has appeared. As Rucker has wittily remarked, they should be called disease departments rather than health departments. This new school will train public health workers in the problems of sanitation, chemistry, industrial hygiene, bacteriology, protozoölogy and kindred subjects with which the public health officer is continually

confronted, and the training will lead to the conferring of the degree of Doctor of Public Health. The institution opened with Dr. William H. Welch as director, and Dr. William H. Howell as director of Physiology.

Flavine and Brilliant Green as Antiseptics. Some of the substances used for antiseptics have considerable bactericidal power, but, as Cushny has stated, they act as general protoplasm poisons, destroying living tissue of all kinds. There have been for many years attempts made to find some substance or substances that would act specifically on the microbes and at the same time leave the tissues uninjured. The observations of Ehrlich on the selective action of dyes and the subsequent studies in a search for salvarsan have added an impetus to the investigations along this line.

Flavine is a diamino-methyl-acridinium chloride and was originally prepared by Benda under Ehrlich's direction. It was found to have very marked therapeutic effect in trypanosome infection, and Browning and Gilmour noted its powerful action on bacteria. It is a fairly stable substance and solutions of it may be boiled or heated up to 120° C. in the autoclave. The bactericidal and antiseptic properties of this substance are said to be quite remarkable, being 800 times more powerful than phenol and its value in this direction seems to be enhanced rather than diminished by admixture with serum. In this respect the drug differs from all other powerful antiseptics that are used at the present time. Flavine has been tested and found to be very potent, both for the staphylococcus and the colon bacillus, and also for anaërobic organisms such as the bacillus of malignant edema. It has less effect on the phagocytosis and on the tissues than any of the substances in common use, and it can therefore be used in much greater concentrations.

Brilliant green is also a very effective bactericide and antiseptic, but does not effect as rapid changes in infected parts as flavine. It seems, however, to stimulate the granulation very well and the authors suggest that it might be used to advantage in filling up large cavities.

Ligat¹ has used these substances in over 150 cases, both septic wounds and injuries newly infected which had not had time to suppurate, with good results. The method used in the suppurating wounds was to secure free drainage by incision, if necessary, and then to irrigate by 1 to 1000 solution of the antiseptic in normal salt solution. Cavities may be lightly packed with gauze soaked in the solution, or wounds may be covered with gauze soaked in it and protective applied to prevent evaporation. Flavine has also been directed directly into the tissues without producing any toxic effect. Fleming,² on the other hand, believes that, from a therapeutic basis, the use of the drug is unsound. He gives as his reasons its strongly agglutinating power on red blood corpuscles up to a dilution of 1 to 3200, and it has a strong anticoagulant effect on human blood. He also states that in dilution of 1 to 2000 it completely inhibits leukocytic emigration, and, if tested for twenty-four hours, its leukocidal action is far in excess of its bactericidal action. In serum, under certain conditions, he found that cocci would grow in 1 to 32,000,

¹ British Medical Journal, January 27, 1917, p. 78.

² Lancet, September 1, 1917, p. 341.

and coli bacillus and *Bacillus proteus* in 1 to 2000, and that, in the case of the last-named organism, the dilution of 1 to 8000 appeared to aid the growth. 1 to 100 injected into the pleural or peritoneal cavities loses its antiseptic power within two hours, and he found that the drug in dilution of 1 to 500 is unable to sterilize in twenty-four hours an equal volume of pus from a wound. When injected intravenously in large doses, it immediately disappears from the blood, which acquires no bactericidal power, and is taken up by the tissues, which become yellow, but acquire no inhibitory power on the growth of the bacteria. Fleming also states that the so-called "therapeutic coefficient" of flavine can be changed with slight variations of the experimental method by at least 300,000 times.

Hewlett³ has also made a study of the germicidal value of flavine and finds that it is much below the statements made by some observers. He suggests that a possible explanation of this is the fact that he used a very much larger number of organisms in his observations.

Etiology of Epidemic Respiratory Infections. Recently there have been quite a number of contributions to this subject, to which I called attention last year. Among the observations were some by Mathers,⁴ who, in addition, has had an opportunity of studying an epidemic infection of the Union Stock Yards Veterinary Hospital. There have been numerous epidemics of acute distemper in horses and sometimes in other animals occurring at the same time as similar epidemics in man, the clinical symptoms consisting of a chill and high fever, and a profuse mucous nasal discharge which becomes purulent in some instances; there are symptoms referable to the gastro-intestinal tract and there may be complications, such as pneumonia, pleurisy, abscesses, etc. The animal is profoundly prostrated. Mathers had an unusual opportunity of studying 100 horses, either sick or dead of the disease, and was able to isolate a hemolytic streptococcus in pure culture, both from the nasal discharges before death and from the infected tissues after death. He also studied the nasal secretions that had been passed through a Berkefeld filter, but was unable to reproduce the disease by spraying the filtrate into the nostrils of horses, nor was he able to cultivate any organism, either aërobically or anaërobically. The hemolytic streptococci were inoculated intranasally in three horses. One developed the typical acute infection three days after the inoculation, while the other two had a slight nasal discharge without any general reaction. This organism corresponds to that which has been described by Hel, Schütz, Pfeiler, and others, in the pleuropneumonia of horses. It seems quite probable that this organism is identical with similar organisms found in man.

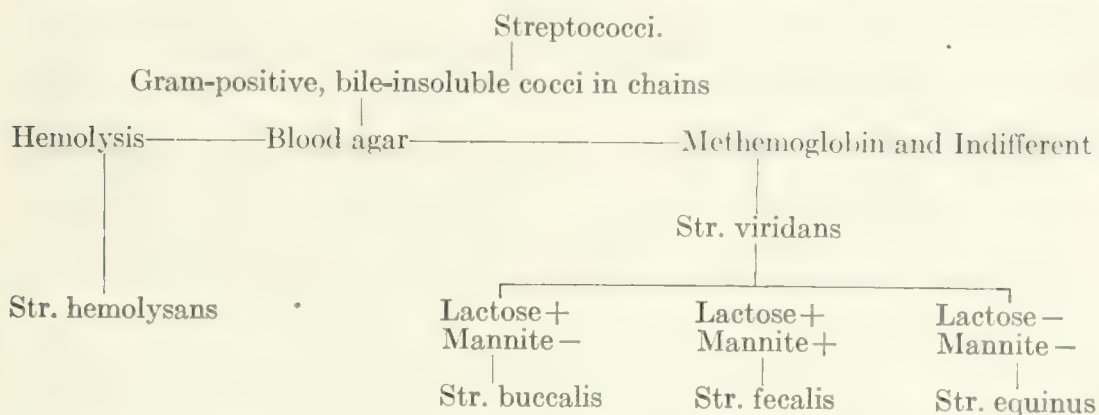
Classification of Streptococci. Space will not permit me to review this interesting subject, but an account will be found in the article by Blake.⁵ To be of routine and clinical value, any classification should depend on very simple technic, but at the same time give some indication

³ *Lancet*, September 29, 1917, p. 493.

⁴ *Journal of American Medical Association*, March 3, 1917, p. 678.

⁵ *Journal of Medical Research*, 1917, vol. xxxi, p. 99.

of the different types of streptococci associated with diseased processes. To this end Blake suggests that they be divided by using the blood-agar plate method, and the following table shows graphically what he suggests:



This appears to be a simplified and adequate method, but the practical difficulty is in getting laboratory workers to adhere to any set classification.

The Keeping Qualities of Therapeutic Serums. MacConkey⁶ has made an examination of a number of different samples of various kinds of serum. Similar studies had been previously made by him in 1913, and by Anderson in 1910, and Miller in 1905. Kinyoun and Hitchins, in 1907, also examined large numbers of samples of returned antitoxin. The higher the potency of diphtheria serums the more rapid is the change, but the loss of value is probably not as rapid as is usually supposed, and under ordinary circumstances the value of the antitoxin is well within the time limit stamped on the labels. If the serums are kept in an ice-chest the average loss is about 7 per cent., and this is doubled when kept at store temperature, which varies at different times of the year. In the few cases where the serum has been examined in bulk, the loss is enormous, very much greater than when it was put up in small packages. MacConkey believes that it is exceedingly important to note the conditions under which the serums are kept. Out of 31 samples which he examined which had been on the market for about two and a half years, the average loss was about 23 per cent., approximately 10 per cent. a year. Tetanus antitoxin loses in strength about the same as diphtheria serum; antiplague serum was found to change but comparatively little in two years if properly stored. Antiscorpion serum was found to change but very little in two years' time. Antidysentery serum, not standardized according to any accepted standard except by other tests, and some serum which had been sent out to India and kept there for one year in an ice-chest and then returned, showed no deterioration.

Actinomycosis Treated by Vaccine. There have been some few cases of actinomycosis treated by this method and reports of single cases are particularly welcome. Dean⁷ reports one such case. His patient was a boy, aged eighteen years, who was affected in the jaw. The fungus was found in the pus. The patient was put on potassium iodide, 15 grains

⁶ British Medical Journal, January 6, 1917, p. 10.

⁷ Ibid., January 20, 1917, p. 82.

three times a day, during the course of his treatment. The initial dose of the vaccine, 25,000,000 fragments, larger than is ordinarily advised, was given on September 18, and was followed by no ill-effects beyond a very slight rise of temperature, and this dose was repeated once a week for a month, the last injection being given on October 9, when the patient was apparently well. The improvement started after the first injection of the vaccine.

Colebrook suggests that the vaccine be used in doses of from 3,000,000 to 10,000,000 fragments about once a week, and lays great stress upon using proper surgical treatment at the same time. He believes that sufficient drainage should be secured and advises the use of a dry swab to clean out the focus if it is small, as he believes that with sharp cutting instruments there is more chance of spreading the infection.

Dysentery Carriers. EMETINE BISMUTH IODIDE IN THE TREATMENT OF CARRIERS OF AMEBIC DYSENTERY. Waddell, Banks, Watson and King⁸ have made a study of this subject, the individuals treated having been found to be carriers of the *Entameba histolytica* in the course of routine examinations in one of the convalescent hospitals. All of the cases came into the hospital as convalescents after dysentery, but there was no particular evidence to show that the acute stage of the disease was due to the *Entameba histolytica*. The drug was used in doses of 3 grains, but administered in 1-grain tablets. After some experimenting it was found that the best time to administer it was after the midday meal. The effect of the drug was rather uniform, practically all being purged or vomited, or both, but generally one or the other effect was predominant. The immediate effect of the drug was rather severe.

Of 102 cases, 19 were not cured. It is possible that this may have been due to the use of some compressed keratin-coated tablets, though for the most part no particular reason for the failure could be ascribed. The remaining 83 cases seemed to have been permanently cured. The total dosage varied between 21 and 36 grains. The observers believe it advisable to keep the cases under observation for not less than fourteen days after treatment, and to examine them not less than four times during that period in order to detect relapses. The drug is without any appreciable effect upon the intestinal flagellates, but has an effect, usually temporary, upon the *Entameba coli*.

A better method of administering this drug has been suggested by Dale, that of giving salol-coated pills as being much less irritating, particularly upon the stomach, inasmuch as if properly made should pass through the stomach without being dissolved.

Similar observations have been made by Lillie and Shepherd.⁹

THE TREATMENT OF CARRIERS OF ENTAMEBA HISTOLYTICA WITH OIL OF CHENOPodium. Walker and Emrich¹⁰ have reported their observations made with the chenopodium treatment at Candelaria Hospital, in Brazil. The oil used had been kept exposed to tropical light and temperature for over a year and had undoubtedly lost some

⁸ Lancet, July 21, 1917, p. 73.

⁹ Ibid., September 15, 1917, p. 418.

¹⁰ Journal of American Medical Association, May 19, 1917, p. 1456.

of its potency. They found the most effective treatment consisted of giving from one-half to one ounce of magnesium sulphate at 6 in the morning and following it with 16 minims of oil of chenopodium at 8, 10 and at noon. At 2 p.m. an ounce of castor oil was given in adults. In children, correspondingly less was given according to age. Of 14 cases treated in this manner, 10 were apparently cured and 4 remained uncured.

The authors believe that the failure to secure a cure in the unsuccessful cases was due to the fact that the magnesium sulphate did not produce free purgation, which they believe to be essential to the favorable outcome. They believe that this method of treating entameba carriers is worthy of further observation.

Arthritis Deformans. Nathan¹¹ has made a very extensive study of this disease with reference to its being an infection. He believes that the majority of cases of the chronic non-suppurative joint diseases are due to a poisoning with infection from some form of microörganism, the exact nature of which is, in many cases, doubtful. In a very large number of cases large numbers of streptococci were found, but the lesion is not infrequently due to other organisms, such as the gonococcus or the staphylococcus.

Ascaris Lumbricoides. THE LONGEVITY OF ADULT ASCARIDS OUTSIDE THE BODY OF THE HOST. The eggs of the *Ascaris lumbricoides*, or round worm, have been kept alive by Wharton in Kronecker's salt solution (physiological sodium chloride solution to which 0.06 gm. of sodium hydroxide per liter is added) for from six to twelve days. Hall,¹² has kept the worms themselves alive in this solution for varying lengths of time. The male worms could be kept alive for fifteen days and three females survived for nineteen days, two of these survived twenty-four days and one was alive on the twenty-sixth day. The worms were also kept alive in normal salt solution for fifteen days.

INTESTINAL OBSTRUCTION DUE TO THE ASCARIS. Perret and Simon¹³ have added an interesting example of this form of intestinal obstruction to the literature of the subject. The patient was a white girl, aged eight years, the past history of whom was negative except that there had been frequent passing of round worms since the age of two. Five days before admission to the hospital, the child was taken with pain in the right lower abdominal quadrant and had a slight elevation of temperature. She began to vomit on the second day and kept it up from then until the time of admission, the vomitus being a clear, watery fluid. A dose of castor oil, given on the second day, produced only a small stool and there was no further bowel movement until she was admitted to the hospital. The child had temperature, rapid pulse and increased respiration, the abdomen was distended and tympanitic, but there was no rigidity. In the left abdomen, about the region of the sigmoid, there was a mass about the size of a lemon. The eosinophiles were 8.5 per cent. A purgative enema was given and a mass of approximately 40 round

¹¹ Journal of Medical Research, 1917, vol. xxxi, p. 189.

¹² Journal of American Medical Association, March 10, 1917, p. 772.

¹³ Ibid., January 27, 1917, p. 244.

worms, coiled and interwoven together and the size of a child's closed fist was passed. The patient made an uneventful recovery, except for a bronchitis.

Intestinal obstruction due to round worms has been reported quite a number of times. Trousseau, Bretonneau, and Stutz each having reported cases. In 1887 Bordoroni and Stepp had 2 cases, both of which were confirmed by autopsy; in 1892 Simon had a similar case; and in 1897 Botoff had a case in which there was perforation and peritonitis as well as obstruction, and over 500 round worms were found. A similar instance was given by Mosler and Peiper, where 25 round worms projected through the opening in the ileum about seventeen and a half inches from the cecum, and the large bowel was completely filled with worms numbering about 500. Smaller numbers of worms, as in the instance just reported, many cause trouble, and in 1899 Taylor had an instance in which 66 were found. Vickery gives an interesting instance of symptoms of obstruction in a pregnant women who had a history of having vomited round worms following the administration of a dose of santonin followed by castor oil. She vomited 12 round worms, and the symptoms of obstruction disappeared. Takaki had a similar instance in a child, aged three years, in which complete recovery followed the vomiting of 115 round worms. Venning also gave an instance of a boy, aged two and a half years, in which the diagnosis was confirmed by operation and 273 worms were removed, but the patient died. Van Meter had a similar instance in which enough worms were removed to fill a wash basin, but this patient recovered.

In PROGRESSIVE MEDICINE for March, 1915, I called attention to some interesting examples occurring in the Italian literature and in which intussusception was complicated with round worms and believed to have been the cause of the intussusception, and Novorro had an instance in which there was obstruction, but in which there were very marked toxic symptoms before the obstruction occurred and he believed that the death of the child was due as much, or more, to the intoxication than the obstruction.

Bronchial Asthma and Bacterial Vaccines. Walker,¹⁴ in the fourteenth study on the subject of bronchial asthma, has found that bronchial asthmatics who are sensitive to the proteins in *Staphylococcus pyogenes aureus* and *albus* are relieved by treatment with vaccines. In the case of the first-named organism, the relief continues for from four to six months, and in the second a shorter time, but a second course relieves a relapse quicker than did the first course. Anyone interested in the subject of asthma and its relation to sensitization to proteins should not fail to consult Walker's studies.

Barcoo Rot. During the Boer war the troops that were moved across the higher parts of Africa developed superficial ulcers of a very troublesome nature. The disease affected both the Boers and the British during the campaign, but the natives were apparently free from it, nor

¹⁴ Journal of Medical Research, 1917, vol. xxxi, p. 423; vol. xxxv, pp. 373 and 487; vol. xxxvi; Journal of Immunology, 1917, vol. ii, p. 227; American Journal of Botany, July, 1917, vol. iv.

did the Boers suffer with it when they were on their farms. There were a number of contributions by various observers, including Harman¹⁵ and Ogston.¹⁶ Harman believed that the sore was in some way connected with the restricted diet necessary during the campaign. Dolbey noted that the troops were not liable to have these sores until they had been in the country at least three months, and they developed under circumstances in which water for washing was exceedingly scarce or wanting, and the soldiers fed on bread and salt biscuit and canned meat with few or no vegetables.

In 1916 Martin¹⁷ observed a disease in the desert east of the Suez canal and he believes that it is identical, or closely allied, to that seen in South Africa. The organism is not to be confused with the ulcerations produced by leishmania infections, known under various names—Bouton du Nil, Clou de Biskra, etc.

In some instances the patients remember having had an abrasion of the skin, but not always. A bleb or blister filled with thin, watery pus and surrounded by a slightly inflamed area then forms and by the time it reaches 2 or 3 cm. in diameter it is generally broken and then the surface left exposed gradually extends and deepens, leaving a somewhat shallow ulceration. Generally there are new foci of infection, so that the patient presents the disease in several stages. If very extensive, it may incapacitate the soldier. When they heal they leave areas of glossy skin, and, if the true skin has been destroyed, there may be some scarring. The infection apparently takes place around the hair follicles and various organisms are found, chiefly the *Staphylococcus albus* and sometimes the *citreus* and *aureus*; there were also diphtheroid bacilli. In the hospital, where it is possible, Martin preferred to use *wet dressings* as a satisfactory method of treatment, but in the hot, dry climates and in the field this is impossible. Harman used *calomel* sprinkled over the ulcer, after cleansing the lesion as fully as possible. Martin suggests that the most effective method is to remove the hairs from the ulcer and also from the margin around it. When this is done, healing generally takes place satisfactorily.

Blastomycosis. Stoddard and Cutler¹⁸ have published a contribution dealing with the different rare forms of infection by various organisms that have been much studied, but which have had so many terms applied to them that a considerable amount of confusion has necessarily arisen. These organisms include the *coccidioides immitis*, blastomyces, oidium, torula and true yeast. The diseased conditions caused by these organisms have been variously described as coccidiosis, blastomycosis, iodiomycosis, saccharomycosis, and torula infections. A number of other terms have also been used. Coccidiosis is a disease that is practically limited to males who have lived in the San Joaquin Valley, in California. Infection with this organism is almost always fatal. In the human being it sporulates and develops hyphæ, but does not bud. The lesion

¹⁵ Journal of Pathology, vol. ix, p. 1.

¹⁶ British Medical Journal, 1901, vol. i, p. 951.

¹⁷ Ibid., June 9, 1917, p. 761.

¹⁸ Torula Infection in Man; Monographs of the Rockefeller Institute for Medical Research, 1916, No. 6.

it produces is suggestive of tuberculosis, and it can be classed with the granulomata. In the air it grows mycelia and aërial hyphæ in cultures and is highly pathogenic for animals. The organisms vary in size from 30 to 40 microns, and are not affected by the iodides. This organism can be separated from the others mentioned above by the fact that they all bud and do not sporulate. The authors suggest that the term blastomycosis, which merely refers to a disease produced by a budding organism, be dropped, and the oidium, torula and yeast infections distinguished from each other. True yeast infections are almost unknown. Buschke has reported 2 cases in which there were involvement of the skin and a general infection, and these seem to be about the only instances. Under certain conditions they form endospores in cultures which separates them from torula.

The *torula infections* are more frequent. They can be separated from the others by the fact that reproduction is by budding and the cultures show no mycelia. In the human being the organism is surrounded by a gelatinous-like zone surrounded by a zone of chronic inflammation made up of lymphoid cells, epithelioid cells, and giant cells. Caseation is not uncommon.

Infection by the oidium differs in that they reproduce in the tissues by budding and the cultures sooner or later develop mycelia. The lesions produced have no gelatinous zone, but consist of small nodules which may caseate or not, and there may also be deep or superficial abscesses, or it may occur as a general infection with lesions in the brain, accompanied by fever and leukocytosis. This infection frequently yields to large doses of the iodides. Animals ordinarily used for laboratory observations are not easily infected. Clinically, there is liability for the infections to be confused.

The *yeast infections* show skin lesions and chronic systemic infection, with abscess formation. The torula infections, of which 6 instances have been reported, produce chronic changes in the nervous system without high fever or leukocytosis. The organism may grow in the brain or meninges, in the lungs, liver, spleen or kidneys, but the skin and bones are not involved.

Cerebrospinal Fever. THE PREMENINGITIC RASH. The ordinary eruption of cerebrospinal fever is a well-known occurrence. Symonds¹⁹ has observed 3 instances of an erythematous rash in about 50 cases of the disease, and in each instance this occurred before there were any symptoms of meningitis to suggest the diagnosis. He describes the rash as consisting of erythematous spots about the size of a finger-nail which faded on pressure and were distinctly papular to the touch. In the first case, the rash came on six hours after the onset and disappeared four hours later; and, in Case 3, the rash was present twelve hours after the onset and had almost disappeared six hours later. Symonds suggests that the rash is an evidence of a general infection and that, as suggested by Lundie, Maclagan and others, there is a septicemic stage in cerebrospinal fever which precedes the meningitis.

CEREBROSPINAL FEVER IN RELATION TO AGE. Compton²⁰ has a short, but exceedingly interesting, contribution summing up the experience of

¹⁹ Lancet, July 21, 1917, p. 86.

²⁰ Ibid., July 7, 1917, p. 14.

the epidemic of 1914-15 and of 1915-16. Taking the actual number of cases observed and dividing them up into periods of five years, in 1914-15, the greatest number of cases occurred between fifteen and twenty and twenty and twenty-five, 37.1 per cent. being between the ages of twenty and twenty-five. In 1915-16 the same figures obtained, except there were slightly higher percentages between fifteen and twenty, and twenty and twenty-five, those coming in the latter period being 43.55 per cent. But to get the real most susceptible age, the percentage of cases over each age period should be referred to the percentage number of people of that age period living in the district at that time. When this is done it is found that by far the greatest susceptibility is between birth and five years of age, five to ten being next, and ten to fifteen after that. After twenty-five the susceptibility seems to be about the same for the various age periods. Compton also believes that weather conditions have a great deal to do with epidemics and that when the weather is very humid, with variations of temperature, the disease is apt to develop.

MENINGOCOCCUS CARRIERS. The Public Health Service²¹ summarized the present-day opinion concerning meningococcus carriers or those individuals who harbor meningococcus without exhibiting symptoms of the disease. This subject is of particular importance at this time because the disease is particularly liable to develop in concentration camps where young adults are brought together. The meningococcus is most frequently found in the nasopharynx, and is probably disseminated by talking, sneezing, or coughing, and in this way, by being implanted on the mucous membrane of another individual, causing the spread of the disease. The carriers may be divided into three types—individuals who are convalescent from an attack of the disease or of posterior basilar meningitis; persons who have been in contact with cases of the disease; and persons who cannot be shown to have had any previous contact with the disease. Some of these are only temporary carriers, the organism disappearing in a few days or weeks, while others are chronic carriers, harboring the organism for several weeks or months.

As the organism is very easily affected by drying, it is necessary, in making cultures, to make immediate transfers to some moist culture media. Swabs are best made from the nasopharynx or the same area as would be covered by the curette in the removal of adenoids. Contamination from organisms in the mouth may be avoided by using a West swab, which consists of a pliable wire passed through a metal or glass tube which is bent so as to facilitate the swabbing of the nasopharynx. After being introduced, the swab is pushed beyond the protecting tube, and, after securing the specimen, the swab is drawn back into the tube before withdrawing it from the mouth. It is also important to put the cultures in the incubator as soon after making them as possible.

Various media are advised, but a freshly prepared agar sheep serum, or laked human or rabbit blood in from 5 to 10 per cent. strength, are generally employed.

The carriers are best treated by keeping them in the open air as much as possible and avoiding contact, especially indoors, with other persons.

²¹ Public Health Reports, July 27, 1917, p. 1175.

The use of sprays, swabs and irrigations were very extensively tried, but no very satisfactory solution has been found up to the present time. Gordon's method of inhalation of chloramine vapors has given some promising results. It would seem that some suitable modification of Dakin's solution, so that it would be unirritating to the mucous membrane, might solve the problem in a satisfactory manner.

Flexner²² has given in detail the various methods of dealing with carriers. All attempts to rid the carrier through inoculation with the killed culture of the meningococcus have failed. In those with a moderate number of organisms present, a 1 per cent. solution of chloramin sniffed up through the nose and expelled through the mouth, twice daily, accompanied with a gargling solution of potassium permanganate, may be tried. Gordon and Flack²³ used a vapor method of applying chloramin and zinc sulphate, using 2 per cent. chloramin-T, and 1.2 per cent. zinc sulphate in water solution. Special apparatus is used to make a steam spray, and one liter of the solution is used in 750 feet of cubic capacity for a period of from fifteen to twenty minutes, during which time the carrier is in the room, inhaling the vapor through the nostrils. This treatment is used once daily. In the majority of instances the organisms disappeared in from nine to ten days.

Dunham and Dakin²⁴ have recommended a solution of dichloramin-T in oil used in an oil atomizer. The nasopharynx may be rendered sterile for aërobic bacteria in a few hours, but reinfection by means of dust brings fresh numbers of bacteria. Flexner summarizes their method as follows:

"1. The nose is cleared with salt solution, or with 0.25 per cent. aqueous chloramin-T solution, either by spraying or irrigation. The nose should be blown into a handkerchief between applications; and the chloramin-T solution should be used thoroughly as a gargle.

2. When the increased flow of secretion from the nose has subsided, the oil solution of dichloramin-T is applied with an oil atomizer. The oil spray should be repeated at intervals so as to make at least four treatments daily about equally spaced from each other. The spraying should be thorough and the oil carried to all parts of the membrane accessible. The first few applications of the oil sometimes occasions sneezing, but tolerance is soon acquired and subsequent applications cause no inconvenience.

3. The preparation of the dichloramin-T oil embraces three steps: First the solvent eucalyptol (United States Pharmacopœia) is chlorinated. Five hundred cubic centimeters are treated with 15 gm. of potassium chlorate and 50 c.c. of concentrated hydrochloric acid for twelve hours or longer, and then well washed with water and with sodium carbonate solution. The water is drawn off and 15 gm. of dry sodium carbonate are added to the oil and the whole is allowed to stand for twenty-four hours. The oil is filtered off, and dried with a little solid calcium chloride, when it is ready for use.

²² Journal of American Medical Association, August 25, 1917, p. 721.

²³ English Report, p. 77.

²⁴ British Medical Journal, 1917, vol. i, p. 682.

Second, the paraffin oil is chlorinated. To 500 c.c. of commercial paraffin oil, 15 gm. of potassium chlorate and 50 c.c. of concentrated hydrochloric acid are added, and the mixture is exposed to light, preferably sunlight, for several hours. It is then transferred to a separating funnel and washed successively with water, a solution of sodium carbonate, and again with water. The opalescent oil is drawn off, solid calcium chloride added, in small quantity, and about 5 gm. of animal charcoal. On subsequently filtering through paper, a yellowish oil, ready for use, is obtained.

The third step is the preparation of the oil solution of dichloramin-T for use in the spray. Two-tenths gm. of the dichloramin-T is dissolved in 2 c.c. of the chlorinated eucalyptol without heating. When the solution is complete, 8 c.c. of the chlorinated paraffin oil are added. After mixing, the solution is ready for use. The solution contains 2 per cent. of dichloramin-T. It is relatively unstable, and should be discarded as soon as a distinct precipitate makes its appearance. An opalescence or moderate cloudiness is not evidence of material deterioration. It is a safe rule not to use the completed solution for more than three or four days after its preparation. It should be protected from strong light and is best kept in a cool place. Where large quantities are needed, a stock 10 per cent. solution of dichloramin-T in eucalyptol may be prepared and kept on hand in a cool, dark place for dilution with paraffin oil, as 1 to 4, as required. The eucalyptol solution will suffer little deterioration in a month."

The solutions of dichloramin-T should not be allowed to come in contact with metal and therefore the atomizers used should be those of all-glass construction.

SUMMARY CONCERNING CEREBROSPINAL FEVER. Flexner²⁵ has contributed a very valuable summary to our information concerning the *mode of infection*, the *means of prevention*, and the *specific treatment* of epidemic meningitis. The organism causing this disease has not been described in nature, apart from its being found in the human being, so it seems highly probable that the organism continues to thrive by being transmitted from one individual to another and so producing the disease, while in others it remains in the nasopharynx and the person becomes a carrier. Some of these carriers harbor the organism for a considerable time, while in others it disappears after a few weeks. The meningococcus generally leaves the body by way of the secretions of the nasopharyngeal membrane, but it is not definitely known whether it gets into the nervous system by way of the blood or directly by way of the lymph tracts. It seems probable that the latter route is the one chosen. Occasionally the organism may be found in metastases in the joints and elsewhere, showing that the blood is capable of carrying it.

Flexner's article goes into details of detecting carriers and the identification of the meningococcus, which need not detain us here. He also gives the details concerning the serum. Before the use of serum, the death-rate from cerebrospinal fever was very high, generally varying

²⁵ Journal of American Medical Association, August 25, 1917, p. 639; *ibid.*, September 1, 1917, p. 721; *ibid.*, September 8, 1917, p. 817.

from 70 to 90 per cent., although occasionally the figures dropped as low as 42.5 per cent. The serum treatment was introduced about 1906, and the results have been pretty satisfactory and would probably be better if thoroughly reliable serums were always used. The mortality, in general, where the serum has been used, has been cut to about 30 per cent. This includes all cases in which serum was given, regardless of the time that it was administered. It is important to note, however, that the earlier the serum was given the better the results. If it is given from the first to the third day, the mortality is about 18 per cent.; from the fourth to the seventh day, about 27 per cent.; and if given after the seventh day about 37 per cent. Some observers, as Netter and Dopter, reported as low mortality as 7 or 8 per cent., where the serum was used before the third day. There are considerable variations in the mortality in different epidemics.

ADMINISTRATION OF THE SERUM. If the patient has clinical signs of meningitis and the fluid is turbid, the serum may be given immediately. The adult dose is 30 c.c., and correspondingly smaller amounts may be used in children. If the examination of the cerebrospinal fluid reveals the meningococcus, two or three additional doses should be administered at twenty-four-hour intervals, even if the patient seems to be doing all right, in order to prevent relapses. In the average case, from four to six injections are usually employed. If the onset is very violent, or the case seen late, the doses may be given at twelve-hour intervals, and in the severe cases usually from six to ten doses are given. When there is a general blood infection, from 40 to 60 c.c. may be given intravenously, and this method is sometimes advised in connection with the ordinary cases. In very severe cases from 40 to 60 c.c. may be given at a dose. These large doses are sometimes successful in cases which do not show any great improvement with the smaller ones. No rules can be given for the continuance of the serum beyond that it should be kept up until the temperature has fallen to normal and has remained so for two or more days, but, if the cerebrospinal fluid becomes clear before the fever disappears, the injections of serum may be interrupted to note what effect it will have on the patient, but it is not well to discontinue its use too abruptly, as there may be a return of the symptoms.

THE STANDARDIZATION OF ANTIMENINGOCOCCUS SERUM. This subject is one which is very timely and important. In 1915 the English had an experience in depending on commercial serums that were not sufficiently supervised. Their later experience²⁶ was that with the proper supervision adequate amounts of potent serum could be produced. The possibility of having an increase in the amount of meningitis due to bringing together large numbers of young men from various parts of the country in training camps makes it highly desirable that an ample supply of thoroughly potent serum should be available.

Amoss²⁷ has called attention to this in a short, but forceful, article in

²⁶ Bacteriological Studies in the Pathology and Preventive Control of Cerebrospinal Fever among the Forces during 1915 and 1916; Special Report Series, No. 3, National Health Insurance, Medical Research Committee, London, 1917.

²⁷ Journal of American Medical Association, October 6, 1917, p. 1137.

which he insists on the fact that if left to themselves the manufacturers of commercial serums cannot all be relied upon to produce thoroughly reliable serums. A meningococcus serum should be so made as to be thoroughly effective against the various groups or strains of meningococcus. According to Amoss, 80 per cent., or more, of all of the cases of cerebrospinal fever are due to two types, one the regular or normal meningococcus, and the other the parameningococcus, while the remaining 20 per cent. are due to two additional strains not quite so definitely characteristic. The English have suggested dividing the meningococci into Types I, II, III and IV. The serums may be tested by a number of methods, testing for the opsonization, complement-fixation, anti-infectious power, and antitoxic power, or by what is a simpler and exceedingly valuable test, by testing the agglutination at 55° C. It has been definitely determined that serums that are potent will agglutinate serums of the organism in question, while those that have little value will not do so. Amoss states that a serum of proper standards should agglutinate in the types just mentioned in dilutions of from 1 to 400 to 1 to 1000. From graphic illustrations and a table showing the results in testing eight different serums it is shown that some of those on the market at the present time are unsatisfactory. The standards of serum, Amoss suggests, should make for a serum that is either free from hemoglobin or contains only a trace of it, and should be a perfectly clear, straw-amber color, or, if slightly turbid, should clear up on standing twelve hours. He suggests that tricresol is to be preferred as a preservative, the strength used not to exceed 0.35 per cent., and, if proper care is used in collecting and bottling the serum, this may be reduced to 0.2 per cent. The containers should be white glass and the labels so arranged as to permit the serum to be seen. These may be protected from light by blue paper or other means. Where dark-colored containers are used, a small amount of the serum should be poured into a test-tube for inspection before injection.

Skin Reactions in Infectious Diarrhea. This has been made the subject of study by Baker.²⁸ In cases with a typical history of infection by the dysentery bacillus the organism can only be isolated from the stools in about 85 per cent. of cases. Baker used bacterial suspensions of the organisms especially prepared and reduced to a powder which can be made up for use as required. The test was carried out in a manner similar to the Schick test, and positive or negative reactions were shown in from six to eighteen hours, usually reaching the maximum intensity in the latter time. Attempts were made to differentiate the type of organism, as well as its group connection, but it was found that positive reactions could be obtained by the intracutaneous injection of the extract of the Shiga bacillus. Thirty-three cases with thirteen controls were studied, and out of these cases the organisms were isolated in 55 per cent. The intracutaneous reaction, however, showed 85 per cent. positive reactions, while the control cases were negative in every case.

Pulmonary Distomiasis. This disease is caused by *Paragonimus westermanii*, Kerbert. Last year I called attention to the work of

²⁸ Journal of Immunology, August, 1917, p. 453.

Nakagawa. The same author²⁹ has published another rather extensive study of the disease in which he found that of the school children in the plains in the Prefecture of Shinchiku, Formosa, 4.3 per cent. were suffering from the disease, while in the mountainous regions, among the savages, it may reach 50 per cent. Three species of fresh-water mollusks were found to act as an intermediate host. The eggs hatch in a miracidia about four weeks after they are first set free in the water, and if they do not reach mollusks they soon die. Secondary intermediate hosts are various species of fresh-water crabs, and the encysted cercariæ were found in the gills, liver and muscles, and, when these were fed to dogs, developed into mature pulmonary distomas and began to lay eggs in about ninety days. The encysted cercariæ, when taken into the intestine, are set free, bore through the jejunum into the abdominal cavity, pierce through the diaphragm, go through the thoracic cavity, and, by piercing the pleura, enter the lung. Here they form cysts and develop into the adult form. The chief causes of the disease are the drinking of river water or eating insufficiently cooked infected crabs.

This work of Nakagawa's has been confirmed by Yokokawa, and also by Kobayaski and Ando, both of whose articles were published in Japanese journals.

The Fasciolopsinæ, or Intestinal Distomas. The increased study of the parasitic diseases of other countries make it very important that physicians, particularly those doing quarantine service, should be familiar with the various findings. The organisms in question have been studied by various observers in China, having been originally described by Busk, in 1843. N. Worth Brown³⁰ has made a study of intestinal flukes, and anyone interested will find a set of very interesting illustrations, together with a table showing the characteristics of the various species of organism.

Hodgkin's Disease. SKIN MANIFESTATIONS OF HODGKIN'S DISEASE. In 1911 Ziegler³¹ reviewed the literature of Hodgkin's disease. This review contained full information up to the date at which it was published, and revealed the fact that about one-quarter of the cases at some time or other showed evidence of skin involvement. Westphal, according to Bunting and Yates, found skin lesions in 15 per cent. of the cases. Cole³² has reviewed the literature and reported some cases of his own; out of 33 cases and 1 questionable case, 13 instances of skin involvement were noted. The most frequent complaint was pruritus which was seen 8 times, a prurigo-like exanthem 6 times, a bronzing of the skin 4 times, petechia twice, urticaria once, and edematous swellings 3 times. The skin lesions can apparently be classified in two groups: First a dry, lymphogranulomatosis acutis; and secondly, a group of lesions probably due to a general infection and yet not showing any characteristic histological changes locally. Cole believes that Hodgkin's disease should be borne in mind and the necessary examinations of blood and lymph nodes

²⁹ Journal of Experimental Medicine, September, 1917, p. 297.

³⁰ Bulletin of Johns Hopkins Hospital, October, 1917, p. 322.

³¹ Die Hodgkinische Krankheit, Jena, 1911.

³² Journal of American Medical Association, August 4, 1917, p. 341.

made in cases of persistent pruritus, urticaria, prurigo-like exanthem, and bronze-like pigmentation of unexplainable origin.

DIPHTHEROID BACILLI AND HODGKIN'S DISEASE. There has been a considerable amount of discussion as to the role of the diphtheroid bacilli in Hodgkin's disease, and I have commented on several different occasions, particularly in *PROGRESSIVE MEDICINE* for March, 1914, and March, 1916, on this subject with particular reference to the organism which Bunting and Yates described. The earlier descriptions of the disease showed that it is frequently confused with tuberculosis of the lymph nodes, but this mistake does not seem to be made as frequently, especially in the laboratory examinations. Cunningham³³ did not find a single instance of tuberculosis in his experience. The same author³⁴ has reviewed the subject and he points out that the organism described by Bunting and Yates, the *Corynebacterium granulomatosis maligni*, has been pretty generally advanced as the cause of the disease, but that there has been very little, if any, work done to show that the organism might be an accidental factor.

Harris and Wade have shown that the diphtheroid organisms are very widely disseminated, and Cunningham found organisms of the diphtheroid group both in the lymph nodes from Hodgkin's disease and from cases of tuberculosis, and in various cultures made in morgues, operating rooms, and laboratories. Warren has called attention to the fact that during several periods this organism was frequently found as a contaminator in blood cultures. Under very strict technic, the cultures made from the lymph nodes from 2 cases of Hodgkin's disease remained sterile. He believes that the organism is only an accidental association and should not be described as the cause of Hodgkin's disease.

Hookworm Disease. **THYMOL AND THE HOOKWORM DISEASE.** Washburn³⁵ has given the results of the use of thymol in the treatment of hookworm disease in Trinidad, and shows that the drug is much more effective when it is very finely pulverized. In the earlier observations, the finely pulverized drug was mixed with an equal amount of lactose. Inasmuch as about 30 per cent. of the persons taking their mixture suffered unpleasant results afterward, and the symptoms were relieved with 30 to 40 grains of sodium bicarbonate, a mixture of equal parts of sodium bicarbonate and thymol was substituted. It was found to be much less expensive and much more effective than the lactose mixture.

HOOKWORM IN CHINA. Hume³⁶ has made a study of the hookworm situation in south China, and found that the disease was widely disseminated and due to soil pollution, and that nothing is being done by the Chinese government to get rid of the disease, the difficulty being the ignorance of the population and the futility of curing persons with hookworm infection without taking any steps to prevent reinfection. It is to be hoped that the various hygienic agencies will be able to satisfactorily combat the disease which has such widespread distribution.

³³ *American Journal of the Medical Sciences*, 1915, vol. cl, p. 868.

³⁴ *Ibid.*, 1917, vol. cliii, p. 406.

³⁵ *Journal of American Medical Association*, April 21, 1917, p. 1162.

³⁶ *Ibid.*, June 23, 1917, p. 1888.

THE USE OF OIL OF CHENOPODIUM IN HOOKWORM INFECTIONS. For various reasons, oil of chenopodium has been suggested as a substitute for thymol. The experience of the International Health Commission of the Rockefeller Foundation, however, shows that sometimes the use of this drug is attended with untoward results. During 1915, in Guatemala, more than 9000 persons were treated with this drug, and particularly favorable results were obtained. Out of these only two persons, both children, had any symptoms to amount to anything, consisting of temporary deafness, lasting, in one, two weeks, and in the other, four weeks.

The standard dosage of oil of chenopodium used in Guatemala is as follows:

Age in years.	Drops.
4	5
5	7
6	10
7	11
8	12
9	14
10	15
11	16
12	18
13	20
14	21
15	22
16	24
17	25
18	27
19	28
20 and over	30

These are maximum doses. They may be administered one at a time or may be divided into two parts and administered one or two hours apart. There is no noticeable difference in results by either method.

Similarly good results were obtained in Nicaragua and in Costa Rica. In Trinidad, however, in a very considerable number of cases there were unpleasant symptoms, such as nausea, vomiting, weakness and dizziness to such a degree that in one of the districts the people became alarmed and were afraid to take further treatment of any kind, but subsequent satisfactory results were obtained by the use of thymol.

The source of the drug was not mentioned, and it would be extremely interesting to know whether the drug was obtained from the same source or not.

In 1916 I commented on the use of this oil, which, according to both Motter and Levy, and Bishop and Brosius, gave some excellent results without untoward symptoms.

Hall and Foster³⁷ have also had satisfactory experiences, especially when large doses of castor oil are administered. They are firm believers in the value of the mixture of chloroform in the castor oil, stating that they consider it as safe as thymol or any other effective drug.

The Kedani Disease. There is an acute exanthematous disease, which is present in the north coast districts of Japan and which has also

³⁷ Journal of American Medical Association, June 30, 1917, p. 1961.

been described in Formosa, which is known under the name of kedani, or the *tsutsugamushi* disease. It is said to resemble Rocky Mountain spotted fever very closely, but Ashburn and Craig have called attention to the fact that it possesses some distinct features. There have been quite a number of contributions made at various times, chiefly in the Japanese literature, and Nagayo, Miyagawa, Mitamura and Imamura³⁸ have published some observations concerning the carrier of the disease. The exact organism has not been established with certainty, but they believe that it is caused by certain piroplasma forms, which they have described as occurring in the spleen, lymph nodes, and in the blood, but which are not found in the red corpuscles. The disease is transmitted by a small mite bearing the names which have been transferred to the disease and also one or two other Japanese appellations. This little insect is somewhat similar to the European harvest bug, *Leptus autumnalis*, and was first described in detail by Tenaka. In this country the shigoe or chigger belongs to the same group.

The contribution in question deals pretty largely with the description of the nymph and prosopon of the organism, which has not been described with certainty and which was supposed not to bite warm-blooded animals. They were also successful in breeding the nymphs and also discovered different variety of the *tsutsugamushi* mite, for which they have suggested the name of *Leptotrombidium akamushi*.

Larva Migrans on the Mexican Border. Creeping eruptions, usually designated under this title, have not found their way into the literature in any very great numbers and the inference has been that they were of more or less rare occurrence. Gray³⁹ has reported his experience with over 100 cases occurring in two regiments over a period of three months. The infection was traced back to a ranch where the men later encamped in an old corral infested with flies. Some of the cases were very severe, and the men suffered greatly from loss of sleep. The eruption was first attributed to prickly heat, but did not respond to treatment. A few days later it was noted that there were small vesicles, followed by small serpentine furrows at the end of which another vesicle would appear, and, after lying dormant for four or five days, would spread again in like manner. The treatment found most efficacious was to paint the vesicle and the burrow with a fine brush with 95 per cent. phenol until the tissue turned white and then painting it with 10 or 20 per cent. tincture of iodine. Only the vesicle and burrow were touched. This was repeated the second day and protected by a dry, sterile dressing, and the patient allowed to rest. Many times it sufficed; in many cases there were recurrences, and in some cases the burrows were so numerous that repeated treatments had to be used, but the end-results were satisfactory.

Monilia Infection of the Lung. A very considerable interest in monilia, or yeast infections, has been noted in recent years. Ashford and also Bahr have advanced the view that *sprue* is due to a monilian infection of

³⁸ Journal of Experimental Medicine, 1917, vol. xxv, p. 255.

³⁹ New York Medical Journal, July 7, 1917, p. 15.

the intestine, and recently there have been two instances of infection of the lung; the first reported by Boggs and Pincoff,⁴⁰ and the second by Simon.⁴¹ Morphologically, the organisms are very similar in appearance, but Simon suggests the possibility of there being two different types, one showing predilection for the intestine, the other for the lung. The organism is smaller than that of the ordinary blastomycosis infection, it is not inclined to form mycelia, does not produce aërial hyphæ, and it differs from the *Coccidioides immitis* of California in that there is an absence of endosporulation and a very evident tendency to multiply by budding.

Simon's case was a male, aged thirty years, who was employed by a gas company; he had lost weight, tired rapidly, had occasional night-sweats, cough, and expectoration. There was no diarrhea and no history of ulceration of the skin, but there were variations in the disease, part of the time the patient feeling very well and at other times very badly. The organisms were found only in the sputum in very large numbers. There were no abnormal physical signs on ordinary examination, but the stereoscopic pictures showed a diffuse infiltration about the hilum of both lungs, extending up to both upper lobes and involving the right middle and lower lobes, the appearance being very much that seen in tuberculosis. The blood did not show very marked changes, the white count being practically normal. The organism was found to be markedly pathogenic for rabbits and produced lesions, particularly in the appendix and kidneys, and slight changes in the lungs. Under full doses of potassium iodide, the cough and expectoration have ceased and the patient has regained his former weight. Whether the effect is permanent or not cannot be stated at this time.

Measles. AN ORGANISM OF MEASLES. There have been, curiously, few observations made with reference to the nature of the measles virus. In 1905 Hektoen succeeded in transmitting the disease in two instances by injecting the blood taken from early cases, but was unable to isolate any organism. A few years later, in 1911, Anderson and Goldberger observed that the rhesus monkey could be given measles by injecting the blood taken from a patient in the early eruptive stage, so that it seems that the virus is present in the blood beginning at least before, and continuing for at least twenty-four hours, after the first appearance of the exanthem. Twenty-four hours after the appearance of the eruption it is already very greatly reduced, and becomes progressively less as time goes on, and soon disappears. In the same year the same observers demonstrated that the desquamated epithelium of measles did not carry the virus, but that the nasal and buccal secretions of uncomplicated cases were sometimes infectious for the monkey. They also determined that the virus passed through a Berkefeld filter, and resists dessication for twenty-five and a half hours; it resists freezing for twenty-five hours; and it may have some infectivity after twenty-four hours at 15° C., but that it loses its infectivity after fifteen minutes at 55° C.

⁴⁰ Bulletin of Johns Hopkins Hospital, vol. xxvi, p. 407.

⁴¹ American Journal of the Medical Sciences, 1917, vol. clii, p. 231.

Tunnick⁴² has made some observations dealing with blood cultures made during the eruptive and pre-eruptive stage of the disease by anaërobic, as well as the previous methods of culture, and did not produce any results. Blood drawn directly from the veins was added to the medium either as it was or sometimes it was collected in sodium citrate solution. Anaërobic cultures were made on various media and incubated at 36° C. No cultures were obtained in the aërobic cultures and none in the fluid anaërobic mediums. Positive cultures were obtained in the largest number in semicoagulated horse serum and in whole-blood ascites-dextrose-agar shake cultures.

The cultures have been made from 50 patients in the pre-eruptive and eruptive stages, and from 5 when the rash was fading. In 42 of the early cases, a small micrococcus was observed, and these were found in all of the last 15 cases studied. Out of the 42 positive cultures, 28 grew slightly for two or three generations only. One strain would grow only on blood agar and remained strictly anaërobic, while 13 became anaërobic in the second culture with a reasonably abundant growth. In smears from the original culture, the organism appears sometimes small, round, sometimes flattened diplococcus or in short chains, sometimes in clumps of varying sizes. The cocci at the ends of the chains are sometimes smaller than those in the center. Carbol-gentian-violet was found to be a satisfactory staining fluid. From the throats of patients, and from cultures made from the nose and eyes, a smaller organism was also isolated, but it could not be found in the blood cultures taken from the five measles patients when the eruption was fading, nor from five normal persons, nor from two suspected cases, nor from three scarlet fever patients. Cultures from this organism passed through the Berkefeld filter N, resisted drying for twenty-four hours, but were all killed at the end of forty-eight hours.

The value of these observations, of course, cannot be determined until further work has been done, but the fact that the cultures of the organism can be filtered is an important one. The results of observations upon animals or upon volunteer human beings would be of great interest.

Meningitis (see also Cerebrospinal Fever). I have previously commented on some of the writings of DuBois and Neal⁴³ with reference to their clinical and laboratory experience with meningitis and so will not go into the details of the summary of their seven years' experience with the various forms of the disease in New York City, which they have detailed with wonderful clearness and which should be read by everyone interested in the subject, even though there is nothing essentially new brought forward. They give just the details that practical workers wish to have information about.

CHEEK SIGN IN MENINGITIS. Several years ago Brudzinski⁴⁴ described a sign in meningitis which is generally known under his name, and that is when the head is flexed on the thorax the patient with an inflammation of the meninges will draw his legs upward and outward. He has recently

⁴² Journal of American Medical Association, April 7, 1917, p. 1028.

⁴³ Archives of Pediatrics, August, 1917, p. 561.

⁴⁴ Berlin, klin. Wehnschr., 1916, No. 25; Il Policlinico, June 10, 1917, p. 771.

described another sign. This reflex consists of a rapid flexion of the forearm when the two cheeks are suddenly pressed on firmly just under the zygomatic region. This sign was first noted in a case of meningitis and then studied in 254 children, both healthy and diseased. In 43 cases of tuberculous meningitis, it was present in 41 and in 1 case it was absent, but this patient showed all the other reflex changes usually seen in meningitis. In 6 cases this cheek sign was present in a stage when the other reflexes were negative. The author believes that it will be of considerable value in the stage when one might suspect a beginning meningitis or typhoid fever. In 1 case in a child seven years of age in which there was a positive Widal reaction, the presence of a tuberculous meningitis was suspected on account of this cheek sign and this later on proved to be the case. In 5 cases of cerebrospinal fever, the phenomena was present in only 1 case and in 11 cases of meningismus was positive in 6 and negative in 5. Like all the other signs of meningitis, this one apparently is present sometimes and absent at others, but in making a diagnosis it is very important to have as many things to point the way as possible and hence this sign is deserving of study.

Epidemic Nephritis. The British army and also the French army have suffered some from an epidemic form of nephritis. Most of the cases developed in France or Flanders, but some also in the Mediterranean area, and it is stated that the same, or a similar, disease has occurred in the German and Austrian troops. Langdon Brown⁴⁵ has given an account of the disease, and it is curious to note that, out of 166 cases, only 5 were in officers. The disease did not bear any definite relation to exposure, and in this connection it may be mentioned that an outbreak which occurred during the Civil war also had no exciting cause of this kind, as the outbreak started in March and lasted for a year. The disease could not be traced to water supply, and although it was suggested that it might be due to lead poisoning from the solder used in food cans, the urinary changes did not bear this out. It has also been supposed that the disease was due to an excess of protein in the diet, with a combined lack of fresh vegetables, and for a while the French army surgeons were of the opinion that the disease might be a form of suppressed scarlet fever. There are numerous other suggestions, but the simplest explanation seems to be that the disease is some sort of specific infection. The blood cultures were sterile and the urine usually so, and various organisms were found in the throat, particularly streptococci. It was also suggested that the infective organism might be filterable. The changes in the kidney consist of a desquamative tubular nephritis, with a few changes in the glomeruli, a point which would certainly militate against the idea of scarlet fever.

The incubation period of the disease seemed to vary between six to fifteen days and some cases seem to show some premonitory symptoms, either bronchitis, or fever, or abdominal pain and vomiting. One of the first things noted was an edema, which was sometimes localized before it became common, and dyspnea was a very common early symptom.

⁴⁵ Practitioner, 1917, vol. xeviii, p. 111.

There was also headache and pains in the back, and some changes in the retinae, together with the usual symptoms seen in nephritis. The treatment suggested by Brown was to place the patient on a low nitrogen diet and the other forms of treatment ordinarily employed.

Another article on this subject is by Sundell and Nankivell.⁴⁶

Clarke⁴⁷ has described the later symptoms and results in what he calls *trench nephritis*. The cases were all seen too late to be the subject of any bacteriological studies. A group of 74 cases showed that 13 had had some kidney affection for a long while; 10 others had had trouble, but it had cleared up before admission; 19 cases were completely recovered; whereas 32 left the hospital uncured, although the majority were greatly improved; 3 patients died; and 8 were more or less permanently disabled. The treatment and the other observations are very much in accord with ordinary nephritis, without reference to any special cause.

The Paratyphoid Infections. Space does not permit me to more than a passing comment on the Goulstonian lectures by Miller.⁴⁸ These lectures give an admirable resumé of our knowledge of the subject.

PARATYPHOID B FEVER. A monograph on this subject has been recently published by Rathery, Ambard, Vansteenbergh, and Michel.⁴⁹ Their observations are based on fifteen months' experience at the Zuydcoote Hospital. During this time, they treated 1088 cases, of which 74 died, a mortality of 6.8 per cent. The organism was cultivated from the patient's blood in 314 cases, and in the others diagnosis was made by agglutination tests. They call attention to the fact that abortive forms of the disease may be met with, particularly toward the end of an epidemic, and also that these mild cases may, at times, suffer very severe relapses. The chief symptoms consisted of a general weakness, generally not reaching the condition met with in ordinary typhoid, accompanied by a loss of appetite, furred tongue, sometimes vomiting or diarrhea, and usually constipation later on. The spleen is somewhat enlarged, the abdomen distended, and there is headache and some pain in the back and muscles. The most common complication is bronchitis. The fever may last for a few days or even weeks and is usually of a remittent type, although in some it was continuous, while in others it was intermittent. Relapses are not uncommon, and small, irregular rises of temperature may be seen during convalescence. The heart may be involved and was the cause of death in 30 cases, pneumonia in some form in 11, intestinal perforation in 9, colitis in 3, pulmonary tuberculosis in 3, diphtheria in 3, parotitis in 3, tuberculous meningitis in 2, purpura and multiple hemorrhage in 2, and otitis in 2. The lesions in the fatal cases resembled very closely those met with in ordinary typhoid. They used vaccines in 147 cases, and believe that it had some value in shortening the course of the disease.

The Prevention of Pediculosis. Considering the amount of suffering entailed by infection by body lice, particularly in armies, there has

⁴⁶ Lancet, September 15, 1917, p. 414.

⁴⁷ British Medical Journal, August 25, 1917, p. 239.

⁴⁸ Lancet, May 26, June 2 and 16, 1916.

⁴⁹ Les Fievres paratyphoides B a l'hôpital mixte de Zuydcoote, Paris, F. Alcan., 1916.

been comparatively little work done on the practical methods of preventing the infection. The provision for baths and for sterilizing clothing have been undertaken, but most of the substances suggested as preventatives in the form of insect powders have been found to be ineffective. Empey describes the ravages of the "cooties," as the British soldier calls them, very graphically in his book *Over the Top*, and states that the vermin seem to thrive on the substances tried as preventatives. Gunn⁵⁰ has made a preliminary note on a method which looks very promising and consists of using undervests dipped in a solution of 1 per cent. each of naphthaline and sulphur in benzol. This mixture was adopted after trying out a very considerable number of other substances. The vests were made out of a very cheap grade of muslin and when treated did not cause any irritation when worn next to the skin. Later on, in the course of the observations, a second-grade gasoline was used, because benzol could not be procured. Drawers were also treated in the same way, though the first observations were made with the vests. The shirts also seemed to have some value in scabies.

Pellagra. In a number of previous issues of PROGRESSIVE MEDICINE I have commented on the observations that have been made on pellagra. For a number of years it was thought possible that this disease might be one of the infections and there was some evidence to show that it might be transmitted by a species of gnat, the similium. It can be pretty definitely stated at the present time that the disease belongs to the deficiency group, due to errors in diet, and while it may be shown in the future that bacteria or other organisms may play some part in the disease, the lack of certain vitamins in the food must be regarded as the most essential feature.

In this connection one might mention the recent observations of Chittenden and Underhill⁵¹ who were able to produce a pellagra-like condition in dogs by feeding them boiled or dried peas, cracker meal containing cotton-seed oil and lard; but changed to a suitable diet brought about a cure when instituted sufficiently early. They believe that this pellagra-like condition is not due to diminished nitrogen intake, or to any inability to maintain a nitrogen equilibrium, or to poor utilization of nitrogen and fat.

McCullom and Pitts⁵² also have held that pellagra cannot be considered to be due to any specific unidentified factor or vitamin, but that it is probably due to not supplying sufficient chemical constituents of the diet, or those supplied are not of the proper nature or that there may be an insufficient amount of the fat-soluble vitamins.

Bacteriology of Pemphigus Neonatorum. Falls⁵³ has made a study of the organisms found in a case of this disease and was able to isolate a strain of *Staphylococcus aureus* which could not be distinguished culturally or biologically from other strains of this organism, but under certain circumstances differed morphologically and also showed different patho-

⁵⁰ British Medical Journal, May 5, 1917, p. 579.

⁵¹ American Journal of Physiology, 1917, vol. xiv, p. 64.

⁵² Journal of Biological Chemistry, 1917, vol. xxxi, p. 239.

⁵³ Journal of Infectious Diseases, 1917, vol. xx, p. 86.

genic tendencies. Typical lesions were produced in man, but while the organism was pathogenic for the lower animals, it does not produce the specific disease in them. This disease has been the subject of a number of observations; as early as 1886 Demme found a non-chromogenic diplococcus, and in 1891 Almquist isolated an organism which closely resembled the *Staphylococcus aureus* when grown on artificial media. This organism, when inoculated into the human skin, produces a vesicular eruption like pemphigus neonatorum, and not the ordinary type of infections characteristic of the *Staphylococcus aureus*. Matzenauer, in 1900, after careful histological and bacteriological studies, concluded that the organisms which he had isolated from cases of the disease and also from cases of impetigo contagiosa were not to be distinguished from *Staphylococcus aureus*. In 1900 Sabouraud suggested that the disease should be divided into two classes, the vesicular type of Tillbury Fox, and the pustular type of Bochart. He believed that the vesicular type was due to streptococci originally, but that they might later be invaded by the staphylococci. Sabouraud's views have not been generally accepted by dermatologists of the present day. In 1900 Block, in a study of 15 fatal cases, found a *Staphylococcus albus* and *Staphylococcus aureus*, as well as a diplococcus, in the skin lesions and was able to isolate a streptococcus from the heart blood in some cases, but he regarded the streptococcus as a secondary infection. Clegg and Wherry, in 1906, in some cases in the Civil Hospital at Manila, described a diplococcus like that described by Almquist, which largely resembled the *Staphylococcus aureus* when grown in cultures. It seems highly probable that the disease should be regarded as due to a special strain of *Staphylococcus aureus*, but there seems to be little doubt that certain organisms, made under conditions the laws of which we are not familiar with, may develop distinctive pathogenic properties without changing their cultural and other biological characteristics.

Poliomyelitis. As might have been expected, there have been an enormous number of contributions based on the experience of various observers during the epidemic of 1916. The New York City Department of Health has issued a very extensive and comprehensive report of some 340 pages, illustrated with figures, maps, and tables, dealing with all the various phases of the subject. Throughout the pages which follow I have commented upon the points which seemed to me to be of most interest, particularly when one takes into consideration the extensive review that I made of this disease in *PROGRESSIVE MEDICINE* for March, 1917. Of the other books that have appeared, the well-known work of Lovett on the treatment of the disease, and a monograph by Draper of some 149 pages on *Acute Poliomyelitis*, a book which takes up the study of a large number of cases and contains many interesting viewpoints, as well as details of the course of the disease in the patients studied. Another publication is a small work by Batten, in England, his Goulstonian lectures somewhat amplified. In connection with Mayer, I⁵⁴ have attempted to give, in a work of some 300 pages, a review

⁵⁴ Ruhräh and Mayer: *Poliomyelitis in All its Aspects*, Lea & Febiger, Philadelphia, 1917.

of our knowledge of the subject up to the present time, including the history, epidemiology, and the clinical manifestations of the disease, together with the treatment, and, in fact, have a tempted to cover all the aspects of the subject. There will doubtless be numerous other contributions in the near future.

One of the most important contributions is a report of a joint committee, representing the Committee on Public Health of New York City, of the New York Neurological Society. This very valuable contribution⁵⁵ is unfortunately published under the Society Reports and is not given the prominence that its importance warrants. The Committee examined a large number of witnesses, including the most prominent physicians who had personal contact with the disease and the analysis of the information thus gained is put under six headings.

BACTERIOLOGY AND PATHOGENESIS. The Committee believes that the organism described by Flexner and Noguchi in 1914, and called the globoid bodies, seems to fulfil, in a general way, Koch's law. They have not been detected in lesions or conditions other than poliomyelitis. The disease has been produced in monkeys by them and the organisms have been recovered from the lesions in these animals. As regards the streptococci, they state that there is some evidence in favor of the view that the disease might be produced by them, but that certain experimental facts seem to argue against it.

IMMUNITY AND RELATIVE INFECTIVITY. There is a very considerable relative or acquired immunity, inasmuch as infants under six months of age and most adults do not readily contract it. The greatest susceptibility is during the third and fourth years, and after the seventh year the natural immunity seems to be rapidly acquired. The Committee believes that the age immunity of poliomyelitis is practically identical with that of measles, scarlet fever, diphtheria and pertussis, but it seems highly probable that there is a natural immunity to poliomyelitis not due to the great prevalence of abortive and unrecognized attacks, but like the natural immunity that occurs against diphtheria, scarlet fever and other infections.

COMMUNICABILITY AND CONTAGION. The Committee believes that the disease is communicable, and that it is immediately contagious and but slightly immediately or personally contagious. They base their views on facts which they collected, the most important of which are as follows:

"1. That only a small percentage of the cases have been shown to have arisen from personal contagion, and in many of these there is not so much proof as inference.

"2. That the great mass of the cases arise without any history of personal contagion.

"3. That multiple or family cases make up only about 3 per cent., and in more than half of these the members of the family were attacked at about the same time, and not sequentially.

"4. That uninfected and healthy children placed in wards containing infected cases do not take the disease.

⁵⁵ Medical Record, September 15, 1917, p. 477.

"5. That in an epidemic time (summer of 1916), in institutions caring for children and offering a fair mark for the disease, there was no infection except in a few instances. That in day nurseries in New York City, babies brought from their homes for the day and taken back at night were not infected.

"6. That in urban and rural populations, the number of cases per 1000 is greater in uncrowded country districts than in the crowded city.

"7. That the small number of cases of personal contagion is not explained on a theory of very high prevalence of natural immunity.

"On the other hand, there are cases which show as plainly as clinical evidence can show, that personal or immediate contagion may occur. Although it is slight, and the immunity rate is high, yet its existence must at present be reckoned with. We only wish to emphasize its small absolute importance, and to urge against burdensome quarantine restrictions based on views of its importance."

They believe that an infected person probably communicates the organism to certain agents, making them carriers of the disease and include as possibilities, human beings, certain of the lower animals, insects, food, dust and dirt. They state that no animal or insect has been positively identified as the ordinary and active carrier of the disease, and there is at present no method of detecting a human carrier. They also state that it seems possible that certain changes occur in the infecting organism which make it possible for the carrier to transmit the disease while the infected person does not.

As regards prophylaxis, hospitalization and quarantine, they believed in following out the directions of the Committee of Conference of State and Provincial Boards of Health of North America, which are given elsewhere in this review.

The section on Early Diagnosis may be passed over, inasmuch as I reviewed this subject fully in *PROGRESSIVE MEDICINE* for March, 1917.

TREATMENT OF THE ACUTE STAGE AND PROPHYLAXIS. They give the following resumé of their opinions concerning these two important features for the management of the disease, as follows:

"In regard to the treatment of the disease in its acute stage, we have received data as to the use of serums—the serums of immunized patients. There is some evidence that the use of such serums does good when it is used in the preparalytic stage or at the very earliest stage of the disease. Injections of convalescent serum, 15 to 20 c.c. intraspinally alone, or in addition to 30 c.c. intravenously and subcutaneously, have been recommended. Normal horse serum has also been recommended, but its use does not seem to be advisable. Most of those who have employed serum of one kind or another are conservative in their statements. They make no claims that they have found a means by which to cope with the disease successfully. It is their belief that since this means of therapy is the only one which has a rational basis, and does no injury to the patient, it is worthy of a trial, and should be used in all cases where the diagnosis may be made prior to the paralysis. The statistics of their observations, while extremely suggestive, fail to bring conviction that a specific remedy for this disease has been discovered.

The intraspinal administration of adrenalin has been recommended, but is still in the experimental stage. Tonsillectomy, advised by some, is endorsed by few. Lumbar puncture has been of use when there is increase of pressure, and, in certain cases, multiple puncture at twelve-hour intervals has been helpful. In respiratory difficulties, morphine may be given to induce a minimum of respiration and oxygen, may be administered by intratracheal insufflation.

No method of making children immune to the disease, or of testing out the question of their immunity by something analogous to a Schick test, has been discovered. The ordinary methods of treating acute attacks have been already widely published, and nothing new has been contributed.

Prophylactic measures, such as spraying of the throat and nose and gargling, are deemed not only unavailing but objectionable, if not injurious, in infants. They may tend to make the mucous membrane of the upper air passages more pervious to the microorganism of the disease.

NEW YORK EPIDEMIC OF 1916. I commented on the epidemic in New York City last year, and anyone wishing further details will find them in the splendid report of the New York City Department of Health, published in 1917, which may be obtained from them or through the book dealers. Shaw⁵⁶ has given a short account of the disease as it occurred in the State of New York, and I am indebted to Dr. Mathias Nicoll, Jr.,⁵⁷ of the New York State Health Department, for the following account which will be found to be of exceptional interest.

From June to December there were 13,000 cases and 3300 deaths. Of these, 8991, or more than two-thirds, occurred in New York City, 4186 representing the cases in other parts of the State. The epidemic began early in June in the borough of Brooklyn. First the spread was slow, but later increased in intensity and invaded practically the entire State. The disease spread along the routes of travel, particularly the suburban lines out of New York City, east into Nassau and Suffolk counties, and northward to the outlying communities in Westchester. The counties bordering on the Hudson River were then invaded, and the disease spread north and northwest along the railroad lines out of the State.

The fatality rate was about 25 per cent., which is higher than the rate observed in any of the previous large epidemics. The table of the epidemic shows an apparent increase in the fatality rate toward the end, but this was probably due to the fact that the number of cases was rapidly diminishing, while the previously reported cases were dying off; this causes the apparent increase in the rate.

In the rural districts a much higher proportion of the population was affected than either in New York City or the up-State cities. On an average, 2.4 per cent. of the persons of the rural sections were attacked, and only 1.6 in New York City, and 0.6 per thousand in the up-State cities, as a whole. The deaths, however, were less in the rural sections, 19.8 per cent.; the up-State cities following with 22.6 per cent., and in

⁵⁶ *Journal of American Medical Association*, July 21, 1917, p. 167.

⁵⁷ *American Journal of Diseases of Children*, August, 1917, p. 69.

New York City, 27.2 per cent. The number of deaths among males was 50 per cent. higher than among females. Practically the same proportion, 60 and 40 per cent., were observed in New York City and up-State, at the different ages and from month to month.

In the first 7500 cases in New York City, almost 80 per cent. were among children under five years of age; over 95 per cent. under ten, and over 98 per cent. under sixteen, while up-State less than two-thirds of the cases were under five years, 86 per cent. under ten, and over 7 per cent. beyond the age of fifteen. In rural New York only 55 per cent. of the cases occurred among children under five years of age, half as many between the ages of five and ten, and 10 per cent. of all cases were among persons older than fifteen. The higher fatality among adults shows a decided contrast in the different sections. In New York City nearly 4 out of every 5 deaths were under five years of age, and 97 per cent. of all deaths occurred among persons under fifteen years of age. In the rural districts 45.5 per cent. were under five years, and 80.9 per cent. under fifteen, with fully 19.1 per cent., or 1 out of every 5 deaths occurring in adults, that is, persons beyond the age of fifteen. It has been suggested that the explanation of the difference is that the urban population has acquired a certain degree of immunity, while the rural population, being more scattered and less in contact, has not.

A study made to determine the length of time persons with the disease were a source of active infection shows that the period is at least eight days after the onset of the disease, and there was very little evidence of the disease being contracted from a person who had been ill longer than two weeks, which suggests the limit of the necessary period of isolation be required for suspected cases in future epidemics.

One of the lessons learned from the epidemic in New York City was the value of publicity and education. The educational campaign in New York was thoroughly done through the newspapers, by distribution of literature, and so on, and the result was that an unusual degree of care was taken of all children as regards cleanliness, food, and all other precautions. The result was that there has been a saving of infant life in New York City sufficient to offset the number of deaths from infantile paralysis. During the first thirty-five weeks of 1916, out of every 1000 infants born 95 died, while during the first thirty-five weeks of 1915 out of every 1000 infants born 105 died. The infant death-rate is a fair estimate of the sanitary conditions prevailing in a community, and this lowering in New York is attributed to the effect of education which resulted from the poliomyelitis epidemic.

Herrman,⁵⁸ in an account of his experience during the New York epidemic, believes that the susceptibility to the disease of children under thirteen years of age is less than to the other communicable diseases of childhood and figures it at about 2 per cent. In his experience, persons who had poliomyelitis seemed to be more susceptible to nasopharyngeal infections than others. In addition, he did not find that children who are susceptible to the disease are any more susceptible than to other more contagious diseases.

⁵⁸ Journal of American Medical Association, July 21, 1917, p. 163.

Craster⁵⁹ has given an account of the disease as it occurred in Newark, New Jersey, in 1916. This city, perhaps, had the severest infection of any large municipality. It is supposed that the virus was carried from the original focus in Brooklyn to Newark in July, 1916, and the first case occurred in the family of an express driver who went daily to Brooklyn.

Direct exposure to patients was known in 79 instances; there were 2 cases in one family reported 66 times. It is interesting to note that there was no note of infection occurring in a hospital. The mortality was 26.3 per cent. during the epidemic, and 85.4 per cent. of the fatal cases were under five years of age, and 83.8 per cent. of all cases were under this age. Craster does not believe that infection by direct contact is the commonest mode of infection, although he believes it possible. He also believes that the disease is carried from place to place by some human carrier.

POLIOMYELITIS IN AUSTRALIA. The review of an article by Cox⁶⁰ showed that the first recognized sporadic cases occurred in 1887, though it seems probable that the disease may have occurred and been unrecognized before that time. One of the cases occurred in New South Wales, and the other in South Australia. In 1890 there were 3 fatal sporadic cases in New South Wales, and in 1893, 3 cases occurred in one family also in the same colony. The first epidemic of any importance occurred at Port Lincoln, in Australia in 1895, and the second in the summer of 1903-1904, when the disease started in Sydney and spread over the greater part of New South Wales and Queensland. This particular season was wet and cool. In 1909 there were a couple of small epidemics in New South Wales, and, following this, something under 50 cases were reported each succeeding year, including 1914. In Queensland there was a small epidemic in 1904, and again in 1914, the latter including over 200 cases. The disease has also been reported from South Australia, Tasmania, and Victoria.

HISTOLOGICAL CHANGES. An article of some interest on the histopathology of human and experimental poliomyelitis is by Hassin.⁶¹ His studies on animals include monkeys, rabbits, and 5 cases in sheep. In the last-named animals the disease was produced by intraperitoneal and intracerebral inoculations of emulsions from human brains of patients who had died from the disease. One was also caused by inoculation of an emulsion of the brain of the first sheep used. Two of the cases were small lambs, both of which were injected intraspinally by Nuzum with 2 c.c. of a cerebrospinal fluid culture and the second with 1 c.c. of spinal fluid culture from a poliomyelitis patient. The histopathological findings in the sheep in these cases were by no means uniform, and the author is careful to state that a definite or sure pathological diagnosis of acute anterior poliomyelitis in the animals of this series could not be made by any means.

Until it has been very definitely proven that the organisms which

⁵⁹ Journal of American Medical Association, May 26, 1917, p. 1535.

⁶⁰ Public Health Reports, October 5, 1917, p. 1663.

⁶¹ New York Medical Journal, July 21, 1917, p. 89.

Nuzum and others have grown are the cause of poliomyelitis, it would not be right to include these observations with those made and in which there was no question of the diagnosis.

Blanton⁶² has also made an anatomical study of 15 cases of acute poliomyelitis, and this article should be consulted by anyone particularly interested in the subject. Among other things, he found ganglion cells in which no change could be made out occurring side by side with other ganglion cells showing extreme injury and lying in a region of advanced cellular infiltration, and also disintegrating cells and sections which were strikingly free from infiltration. These observations have led Blanton to the older view held by Charcot and Joffroy, Dejerine and Rissler, and others, that the ganglion-cell injury is not necessarily secondary to the interstitial changes of edema, congestion and cell accumulation, but is very likely the result of injury due to the toxins of the organism, or the organism itself in some way. The more recent observations of Goldscheider, Starr, Taylor, Wickman, Strauss, and others, have expressed the opposite opinion, that the ganglion-cell changes were secondary to the infiltration. Bruining is one of the more recent writers who takes the older view.

Blanton also noted that while the thymus usually appeared normal on macroscopic examination, regressive changes were noted microscopically, the small thymic cells very often showed signs of injury and the large phagocytic mononuclears were sometimes nucleated or sometimes contained quantities of nuclear débris. In a study of the pathology of the thymus gland, Poppenheimer pointed out that the thymus is exceedingly susceptible to injury and that changes may take place with astonishing quickness, both in acute and chronic infections.

THE RELATION OF THE NOSE AND THROAT TO POLIOMYELITIS. In the New York epidemic of 1916, a study was made to determine if there was any relation to diseases of the nose and throat and poliomyelitis and whether the disease was more common with adenoids and tonsils than in those in whom they had been removed. It was found that a large number of children with poliomyelitis had pathological conditions of the nose and throat, either disease and hypertrophy of the tonsils and adenoids, or both. This, of course, would be expected, as disease of the tonsils and adenoids is extremely common at the present day in early life. It was also noted that a large number of children with poliomyelitis showed marked hyperemia of the nasopharynx and throat, that is, of the tonsils, anterior pillars, and soft palate. This condition often resembled that seen in scarlet fever, or due to infection with a streptococcus. It was also observed that only a small percentage of cases previously operated on for tonsils and adenoids were found afterward with the disease, and in that group of cases the percentage of recoveries was very much higher than in unoperated cases. The number is too small to draw any very definite conclusions, but at the same time it is very suggestive.

A series of 2000 cases was studied. Of these, 45 had been operated upon; 19 out of 39 of these recovered completely, or 46 per cent.; 1955

⁶² Journal of Medical Research, 1917, vol. xxxi, p. 1.

cases were not operated upon. There were complete recoveries in but 15 per cent. While these observations are striking, one should be slow in jumping at any conclusion, and they should be confirmed by other observers in other localities before being made a basis for practical application.

Another study was undertaken on 1404 children whose tonsils and adenoids had been removed. Not one of these developed the disease, although in 18 instances cases developed in the family, and in 93 instances in the same house.

POLIOMYELITIS AND DECAYED TEETH. Fischer⁶³ suggests the possibility of the infection entering through carious teeth. Whether or not this is the case, the mere suggestion is a very strong point in urging the all-important dental hygiene, a much-neglected point, particularly in children.

POLIOMYELITIS IN LOWER FLOORS. A point of extraordinary interest is brought out in the New York epidemic of 1916, in which it was found that most of the cases of the disease occurred on the first and second floors of the taller houses and a very much lesser proportion of cases on the floors above. The explanation of the greater number of cases on the lower floors may be due to the fact that they have less light, less air, and are more exposed to rodents than the upper floors. Scarlet fever and diphtheria do not show this tendency.

This point may be of importance in solving the problem of transmission, inasmuch as it seems to be a point in the favor of the possibility of the disease being transmitted by rat fleas.

THE EARLY RECOGNITION OF POLIOMYELITIS. I commented at some length on this subject in *PROGRESSIVE MEDICINE* for March, 1917, so that it will not be necessary to repeat what I wrote at that time, but merely to call attention to some of the contributions on this subject, as the one by Haynes⁶⁴ and to the statement of Jeans and Johnston⁶⁵ who believe that the colloidal gold reaction will be sufficient to differentiate between poliomyelitis and conditions giving a normally appearing cerebrospinal fluid, as meningismus. Draper⁶⁶ has described the various phases of the disease very well and suggests the name of dromedary group for those cases which show an interval of well-being between the two periods of illness. If the disease is regarded as a general infection, one can readily assume that in a great number of instances the virus does not get into the nervous system at all, so that the only manifestations of the disease are fever and its accompaniments. These cases get well and may escape recognition entirely, or they may be called abortive or non-paralytic cases. In the dromedary group the virus produces symptoms of a general infection first, then there is a remission, and at the time the virus enters the nervous tissue there is again fever and the production of more or less intense nervous symptoms, together with paralysis in many instances. In other cases the child is ill for two, three or more

⁶³ Weekly Bulletin of the Department of Health of New York, May 12, 1917, p. 146.

⁶⁴ Archives of Pediatrics, June, 1917, p. 401.

⁶⁵ American Journal of Diseases of Children, vol. xiii, p. 239.

⁶⁶ Journal of American Medical Association, 1917, vol. lxviii, p. 1153.

days and there is no remission in the illness, and these are doubtless cases in which the original dose of the virus is either greater or more intense, or else the individual's resistance is lowered, or the symptoms of a general infection keep up until the nervous symptoms are manifest; and there is still another group in which the symptoms are marked from the first, and these may be due to the virus reaching the nervous system before it enters the body, the original infection producing very slight general symptoms for some reason or other.

Neustaedter⁶⁷ believes that paleness and edema of the nasopharyngeal mucosa accompanied in the early stages by a serous and frothy transudate is constant and pathognomonic of the earliest prodromal stage. Colliver⁶⁸ gives a table of the early symptoms in which he mentions the changes in disposition, fever and anorexia, with constipation or diarrhea, lack of coördination, hypersensitiveness of the skin, drowsiness, pain, tremor of certain groups of muscles and hyperacusis in the bulbar cases. Other articles in this connection and with reference to the symptomatology are by Koplik⁶⁹ and Fischer⁷⁰ who lays great stress on what he designates as Colliver's sign, that is, the tremor and twitching of the muscles. Gordon⁷¹ lays considerable stress on the value of studying the reflexes, particularly the patellar and Achilles, and that, during an epidemic, cases that show either an exaggeration or diminution should be regarded with great suspicion. Sheffield⁷² comments at some length on the symptomatology and calls attention to the frequency with which the disease starts with sore throat, and in which the diagnosis of tonsillitis may be, and often is, made. The Harvard Infantile Paralysis Commission⁷³ reviews its work and states that of 187 calls received, only 123 proved to be poliomyelitis. Wilson⁷⁴ has also made a study of the prodromal symptoms and lays particular stress upon obtaining a careful history of the attacks as leading one to a correct interpretation of symptoms. She made a study of 400 patients in the Willard Parker Hospital.

LABORATORY DIAGNOSIS. I commented on this subject last year. There have been a number of interesting and important contributions including one each by Neal,⁷⁵ Zingher,⁷⁶ Abramson,⁷⁷ and Kolmer.⁷⁸ Zingher suggests the two bedside tests, the *foam test*, in which the spinal fluid is shaken in a test-tube, the fluid from meningitis and poliomyelitis produces a more persistent and denser foam, and also the *ground-glass appearance of the fluids* when viewed by transmitted light. Zingher also has an extensive article in the report of the New York Board of Health. Kolmer has studied the cerebrospinal fluid in a number of different

⁶⁷ New York Medical Journal, 1916, vol. civ, p. 145.

⁶⁸ Archives of Pediatrics, 1917, vol. xxxiv, p. 263.

⁶⁹ Journal of American Medical Association, 1916, vol. lxxvii, p. 310.

⁷⁰ New York Medical Record, 1916, vol. xc, p. 194.

⁷¹ New York Medical Journal, 1916, vol. civ, p. 583.

⁷² New York Medical Record, 1916, vol. xc, p. 330.

⁷³ Boston Medical and Surgical Journal, 1917, vol. clxxvi, p. 637.

⁷⁴ American Journal Diseases of Children, 1917, vol. xiii, p. 516.

⁷⁵ New York Medical Journal, 1916, vol. civ, p. 167.

⁷⁶ Journal of American Medical Association, 1917, vol. lxxviii, p. 187.

⁷⁷ New York Medical Record, 1916, vol. xc, p. 793.

⁷⁸ Archives of Pediatrics, June, 1917, p. 413.

ways and has found that, as might be expected, the cerebrospinal fluids may show an *increased protein*, and, in connection with Matsunami, he has made a comparative study of the various methods of detecting it and believes the Nonne-Apelt technic the most satisfactory. In connection with the same observer, he studied the *reduction reaction of Mayerhofer*,⁷⁹ using potassium permanganate, but, after examining 78 fluids from various cases, he came to the conclusion that it was of no value. Kolmer, in connection with Meine, has also studied the *permeability of the meninges and choroid plexus* by using the Weil-Kafka hemolysin reaction. In ordinary individuals, over 90 per cent. contained natural antishoop hemolysin as a substance, which, in the presence of complement, will hemolyze the red blood corpuscles of sheep. This substance is not present in the normal cerebrospinal fluid, but when there is acute meningitis this hemolysin may pass through the choroid plexus and so be present, and it has been demonstrated in cases of acute meningitis. In the cases studied 66 per cent. showed the hemolysin alone, and 30 per cent. showed both the hemolysin and complement, while all the control fluids were negative. This test, of course, has no specific value, merely that it shows that the permeability of the choroid plexus has been interfered with. In connection with the same observer, Kolmer found that Hauptmann's saponin reaction was negative.

THE COLLOIDAL GOLD REACTION TO THE CEREBROSPINAL FLUID IN ACUTE POLIOMYELITIS. After studying the cases in a small epidemic occurring in Baltimore in 1916, Felton and Maxcy,⁸⁰ have given the results of their studies in reference to the reactions with Lange's colloidal gold test. This test was carried out according to the method advised by Miller, Brush, Hammers and Felton,⁸¹ whose article should be consulted by those unfamiliar with the reaction. They suggest that the different reactions be classified as occurring in zone 1 (paretic zone), maximum precipitation from 1 to 10 to 1 to 60, with complete decolorization; zone 2 (luetic), maximum precipitation from 1 to 40 to 1 to 60, with decolorization up to 4 (light blue); zone 3 (meningitic), maximum precipitation beyond 1 to 160, producing a maximum decolorization of 3 (blue). In the acute stage the fluid reacts in dilutions of from 1 to 40 and from 1 to 160. Later on in the disease, in the second and third weeks, the reaction either remains the same or there is a tendency to clear up in some cases, while in others there is precipitation in higher dilutions. During this period there is no constant rule. In the fourth to the eighth week the reaction returns practically to the globulin-albumin content, and still occurs in dilutions of 1 to 40 and 1 to 160. The authors suggest, inasmuch as the reactions occur constantly in the same zone, that they may be of help in making a diagnosis in poliomyelitis.

Jeans and Johnson⁸² also made a study of the gold chloride test with a result about as given above. They found the reaction occurring in the lower dilutions and when that did occur in the middle or meningitic

⁷⁹ Journal of the American Medical Association, 1917, vol. lxxviii, p. 152.

⁸⁰ Ibid., March 10, 1917, p. 752.

⁸¹ Bulletin of Johns Hopkins Hospital, 1915, p. 391.

⁸² American Journal of Diseases of Children, 1917, vol. xiii, p. 239.

zone it was not restricted to the middle zone, but also appeared in the first zone.

COMPLEMENT-FIXATION IN POLIOMYELITIS. Kolmer and Freese⁸³ have made a study of this subject which had previously been studied by a number of different observers, including Wollstein, who obtained negative results in a small series of cases; Lebrede and Recio, who tested 3 cases and said they got a positive reaction in 1, using extracts of various organs as antigens. Gay and Lucas, in a series of tests could find no evidence of antibodies or antigen in the spinal fluid and blood serum of monkeys with the disease, or in human beings. Kolmer and Freese found, in employing very delicate technic by using large doses of antigen and cerebrospinal fluid, that a small percentage of positive reactions occurred with salt solution in the spinal cord, pons and medulla, cerebellum, cerebrum, spleen and liver of fatal cases of the disease. They found that alcoholic extracts from these tissues were negative. Extracts from the liver and spleen showed a greater number of reactions and a greater degree of inhibition of hemolysis than extracts made from the other tissues. They suggest that the results indicate that the antibody substance concerned in the test is present, or at least more easily detected, in cerebrospinal fluid than in serum, but they also state that the micrococci, so easily cultivated from the cerebrospinal fluid of poliomyelitis, may possess sufficient virulence to produce antibodies, but this would not necessarily indicate that they should be regarded as the cause of the disease. The results, in the main, are in accord with those of other observers, that is, the reactions are too irregular and weak to be of any practical value in the diagnosis of the disease.

THE PERSISTENCE OF IMMUNE BODIES. The length of time the immune bodies last in the body is a matter of conjecture. Flexner and Amoss⁸⁴ report an instance in which they found the immune bodies on the sixth day of the disease, and they have been found years afterward. Netter is of the opinion that the most potent serum is found between three months and four years after an attack of the disease.

THE SPINAL FLUID AND THE VIRUS OF POLIOMYELITIS. Abramson⁸⁵ has a short, but interesting, article on this subject. Efforts to demonstrate the virus of poliomyelitis in the spinal fluid of human patients suffering with the disease have all proved negative, but Flexner and Lewis were able to demonstrate it in the cerebrospinal fluid of an infected monkey three days after the intracerebral injection of the virus, which suggests that in some period the virus may be present, even though it be in such small quantities as not to be capable of demonstration. Nuzum and Herzog, in 90 per cent. of cases were able to grow the Gram-positive coccus from cases of the disease in human beings. Abramson, on the other hand, in a study of 1200 fluids from patients with acute poliomyelitis in all stages, using similar culture media, was unable to get any growths whatever, except a few evident contaminations. In 40 instances the fluids were centrifuged at high speed for three-quarters of

⁸³ *Journal of Immunology*, April, 1917, p. 327.

⁸⁴ *Journal of Experimental Medicine*, 1917, vol. xxv, p. 499.

⁸⁵ *Journal of American Medical Association*, February 17, 1917, p. 546.

an hour, and the sediments amounted to 1 c.c. of very turbid fluid. This was injected into a rhesus monkey. Cultures inoculated with some of the sediment remained sterile, and the monkey did not develop the disease during a period of two months. After this time the animal was inoculated with 0.5 c.c. of poliomyelitis virus and developed the disease after an incubation period of eleven days.

NEUTRALIZATION OF THE VIRUS OF POLIOMYELITIS BY NASAL WASHINGS. Amoss and Taylor⁸⁶ have made some interesting experiments and have shown that the washings of the nasal and pharyngeal mucosa possesses a definite power to inactivate or neutralize the active power of poliomyelitis. This power varies at different times in the same individual, and inflammatory conditions of the nose and throat either diminish or inhibit the power of neutralization entirely. The neutralizing substance is water-soluble and apparently is organic. Its action apparently does not depend upon the presence of mucin as such. They have not made a sufficient number of tests to ascertain whether adults and children differ with respect to the existence of this neutralizing property in the nasal secretions. They suggest that it is possible that the production of healthy carriers through contamination with the virus may be determined by the presence or absence of this inactivating or neutralizing property in the secretions. This subject may prove to be a fertile field for further investigation, and it would be exceedingly interesting to have determined what effect antiseptics have on these substances.

THE CHOROID PLEXUS AND THE VIRUS. Flexner and Amoss⁸⁷ have shown that the meningeal choroid plexus is normally capable of excluding from the nervous system the virus circulating in the blood and also in preventing infection from the virus present on the nasal mucosa. They have found that normal monkey or horse serum, isotonic salt solution, Ringer's solution, and Locke's solution, when injected into the meninges, cause an irritation which diminishes the protection of the choroid plexus and permits the virus of poliomyelitis introduced into the blood to pass into the central nervous system. Simple lumbar puncture, when there has been no hemorrhage, does not seem to have any influence upon the passage of the virus into the central nervous system; but if there has been hemorrhage, this seems to increase the permeability. Immune serum is the only substance which is not succeeded by infection from the virus introduced into the blood. These observations would seem to be another reason for using immune serum in preference to any of the other substances suggested.

Flexner and Amoss have kept specimens of virus of poliomyelitis in the spinal cord and medulla of human beings and monkeys in 50 per cent. glycerol at refrigerator temperature for six years. The specimens had lost a part of their activity and it took larger and repeated doses to produce infection. The tissues employed did not show any streptococci or other ordinary bacteria.

⁸⁶ *Journal of Experimental Medicine*, April 1, 1917, p. 507.

⁸⁷ *Ibid.*, p. 525.

TEMPERATURE AND PULSE IN POLIOMYELITIS. McMillan⁸⁸ calls attention to the lack of relation between the temperature and the pulse rate. He describes his observations as follows: "With the initial rise of temperature at the time of the onset, there is an initial rise of the pulse rate. The pulse began to fall at the same time that the temperature fell, but more rapidly in proportion. Upon hitting the low mark, the pulse rate often increased to a marked degree while the temperature continued to fall to normal or subnormal. In general figures, the pulse rate in children from two to five years of age varied from 80 to 200, and the cases in which the pulse rate rose to over 160 rarely recovered." He also calls attention to that fact that there may be a change of over 30 to 40 beats without any change of temperature, and that in the fatal cases the pulse may become so rapid and thready as to be uncountable. The respiration rate may follow the pulse rate, roughly speaking, about one-third or a little less to the rate of the pulse.

THE EYE COMPLICATIONS OF POLIOMYELITIS. There have been very few observations made on the eye complications and there is some difference of opinion regarding the state of the eye-grounds. Tedeschi reported a case in which there was *optic atrophy* in an old case. Wickman reported *optic neuritis* in a recent case, but Müller, in a study of a considerable number of cases, did not find any changes in the eye-grounds and was of the opinion that if any change was present the case was not to be classed as poliomyelitis. Posey and Swindells⁸⁹ have reported an instance of a boy, aged seven years, who was taken with poliomyelitis on August 19, and three days later developed complete paralysis of the right arm and leg. On September 16 the movements had returned rather completely, but there was still slight deltoid paralysis. On September 12 there was a *diplopia*, due to paralysis of the sixth nerve. Total blindness, widely dilated pupils, slightly greater on the right side, followed. Thirty-seven cubic centimeters of clear fluid were removed by lumbar puncture, and the pains and headache, which the child had had, disappeared. He was seen by Posey on September 25. Had large, non-reacting pupils, total blindness in each eye, the optic nerves were grayish white and the outlines sharply defined. There was marked reduction in the size of the retinal vessels. Movements of the eye were good, with the exception that the child could not rotate the left eye outward. Diagnosis was made of simple *atrophy* with *paralysis of the left sixth nerve*.

The later literature, prior to the article of Uthoff⁹⁰ contained no mention of the optic nerve being affected in poliomyelitis. Posey was inclined to believe that the optic atrophy in his case was due to complicating meningitis. The involvement of the cranial nerves is not infrequent. The following tables give some idea of what has been observed, and, together with Mayer, I reviewed this matter at some length in our book on *Poliomyelitis*:

⁸⁸ New York Medical Record, February 3, 1917, p. 204.

⁸⁹ Ophthalmic Record, 1916, vol. xxv, p. 609.

⁹⁰ Graefe Saemisch, XI, vol. ii, p. 308.

“In the Swedish epidemic of 1905 Wickman collected 42 cases out of 685. These were arranged as follows:

	Cranial nerve affec- tions associated with spinal nerve affection.	Cranial nerves alone affected.
VII	12	14
XII	9	9
Eyes	5	3
VI	4	2
III	4	2
IX to XI	5	4
V	2	
II	1	
Total	42	34

In 338 cases at the Queensboro Hospital, in the New York epidemic of 1916, there was cranial nerve involvement in 46 cases, arranged as follows:

	Cranial nerve affection.
Optic	2
Oculomotor	2
Fourth	1
Abducens	12
Facial	26
Glossopharyngeal	2
Hypoglossal	1
Total	46

THE ACCURACY OF DIAGNOSIS. During the recent New York epidemic, 9418 cases were reported, of which 4474 were treated in health department hospitals. Of these, 96 were found, after observation, to be free from any serious illness. Of the remaining 4378, 49 were found to have some other disease. This is an unusually good showing, being approximately only 3 per cent. of the patients sent to the hospitals with other diseases, which, considering the intense public interest with the consequent state of mind of both the public and profession, is a very creditable record. The following is a list of the cases, which is of very considerable interest:

No illness	96
Hysteria	2
Uremia and nephritis	1
Tuberculous meningitis	8
Rachitic pseudoparalysis	1
Pulmonary tuberculosis	1
Purulent pleurisy	1
Tetany	1
Gastro-enteritis and meningismus	1
Cerebral thrombosis	1
Epilepsy and arthritis	1
Mentally defective (idiocy)	1
Streptococcus meningitis	1
Purulent peritonitis	1
Intussusception (?); gastro-enteritis	1
Dentition	1
Congenital calcaneovalgus	1
Bronchopneumonia; pertussis	2
Cervical adenitis and cellulitis	1

Bronchopneumonia	2
Diphtheritic paralysis	2
Malnutrition and spasmophilia	1
Seven-year-old case of infantile paralysis	1
Pericarditis	1
Kyphosis (Pott's disease)	1
Cerebrospinal meningitis	3
Hemiplegia and syphilitic endarteritis	1
Transverse myelitis specific (?)	1
Influenza meningitis	1
Pneumococcus meningitis	1
Cerebral arteriosclerosis with traumatic neuritis of supra-orbital nerve	1
Spastic paralysis (congenital tetanoid pseudoparaplegia)	1
Chorea	1
Bell's palsy	1
Septic arthritis	1
Hemiplegia, cerebral hemorrhage	1
Measles	1

Of 2715 patients followed up in their homes, 1885 were found to have a serious paralysis of one or both legs, and to be unable to walk; 530 were particularly paralyzed in the legs, but able to walk; and 273 had one or both arms totally paralyzed.

THE BACTERIOLOGY OF POLIOMYELITIS. The earlier investigations on the bacteriology of poliomyelitis were largely limited to the finding of diplococci or micrococci in the cerebrospinal fluid. Bülow-Hansen and Harbitz⁹¹ isolated a diplococcus from acute cases, and Harbitz and Scheel⁹² confirm their observations. Geirsvold⁹³ found a diplococcus in 12 cases and claim to have caused paralysis and death by inoculation into animals. Pasteur, Foulerton and Maccormac⁹⁴ found a micrococcus in the fluid which, when inoculated into rabbits, produced a disease condition similar to that seen in human beings. Similar observations were made by Dixon and Fox in the Pennsylvania epidemic of 1907, and they found a diplococcus not only in the cerebrospinal fluid, but also in the nose and throat of patients suffering with acute attacks of the disease, and Rucker⁹⁵ studied this diplococcus, which would seem to be similar to that described below in the consideration of the recent investigations.

RECENT INVESTIGATIONS OF THE CULTIVATION OF THE VIRUS. Several articles have appeared recently dealing with this subject, the first by Mathers,⁹⁶ the second by E. C. Rosenow, Towne and Wheeler,⁹⁷ and the third by Nuzum and Herzog.⁹⁸ All these articles deal with the cultivation of a micrococcus. Mathers used the material from the brain and cord obtained at autopsy under sterile conditions, and as soon after death as possible, and inoculated it into the various mediums, as ascites fluid and ascites-dextrose agar containing a small piece of rabbit kidney, ascites dextrose broth, and coagulated with normal horse serum. The cultures

⁹¹ Norsk. Mag. Laegevidensk., 1898, vol. xiii, p. 1170.

⁹² Journal of American Medical Association, 1908, vol. 1, p. 281, and *ibid.*, vol. xlix, p. 1420.

⁹³ Norsk Mag. Laegevidensk., 1905, p. 1280.

⁹⁴ Archives for Middlesex Hospital, London, 1908, vol. xii, p. 208; *Lancet*, 1908, p. 484.

⁹⁵ Reports of the Health Department of Pennsylvania, 1907, p. 420.

⁹⁶ Journal of American Medical Association, September 30, 1916, p. 1019.

⁹⁷ *Ibid.*, October 21, 1916, p. 1202.

⁹⁸ *Ibid.*, p. 1205.

were made both aërobically and anaërobically, and were incubated at 35° C., for from one to seven days. In 7 of 8 cases, after thirteen hours in aërobic cultures, and in from three to seven days in an aërobic cultures, a Gram-positive micrococcus was obtained, and in 6 of these the organism was in pure culture. Cultures from the heart blood and from the cerebrospinal fluid after death did not show the organism, but it was demonstrated in the mesenteric lymph nodes. It is of low virulence for rabbits, but when injected into the veins in large doses, lesions of the central nervous system are produced, with paralysis, particularly of the extremities. Intracerebral injections into a monkey also caused paralysis. After three or four transfers on artificial mediums, the organism seems to lose its affinity for the nervous system.

Rosenow, Towne and Wheeler made a study of the throats, tonsils, spinal fluid, blood, central nervous system and other tissues, and isolated a peculiar polymorphonuclear streptococcus from the throat and tonsils, and from abscesses in the tonsil in a large series of cases of epidemic poliomyelitis. They also obtained it from the ventricular fluid after death and from the blood in one instance, but not from the spinal fluid. Their organism was apparently the same as that of Mathers.

The cocci, when grown under anaërobic conditions, has a tendency to become very small, and suggested the globoid bodies described by Flexner and Noguchi; the smallest of these could be filtered through Berkefeld filters, while the larger ones could not. It is now suggested that the globoid forms described by both authors may be due to the breaking down of some of the larger diplococcus forms.

Another recent study has been made by Kolmer, Brown and Freese.⁹⁹ They found, in cases of acute poliomyelitis, that four different kinds of microorganisms could be grown without difficulty. These were streptococci, diplococci, diphtheroid bacilli, and Gram-negative bacilli. The streptococci were found to be grown both aërobically and anaërobically, and under the latter conditions the organisms became small and round, and they were more easily decolorized with alcohol in the Gram stain than the others. These organisms were not found in the cerebrospinal fluid in 106 different observations, but they were found in one of 20 anaërobic blood cultures, and in fatal cases were easily isolated from the nervous tissue, tonsils, liver, lungs, kidneys, spleen, pancreas, thymus gland, suprarenal glands, and mesenteric lymph nodes. The diplococci are Gram-positive and, when transplanted to solid media, grew abundantly and looked like a staphylococcus that grew both aërobically and anaërobically, and under the latter conditions the growth was slow and the cocci became small and round. They found these organisms in 48 out of 106 cerebrospinal fluids, and also in the nervous tissue and organs mentioned above. These organisms did not produce any paralytic conditions, either in rabbits or in monkeys, but the streptococci set up arthritis and meningitis. These organisms are apparently secondary to the real cause of poliomyelitis, or else are terminal infections. Perhaps the chief reason for doubting that the streptococci are the cause of

⁹⁹ Journal of Experimental Medicine, June 1, 1917, p. 789.

poliomyelitis is that where they have produced lesions in the nervous system they have done so in animals that have ordinarily been found refractory to the virus of poliomyelitis obtained by ordinary methods. It is well known that almost any organism injected into an animal will find its way into the nervous system and cause lesions, providing the animal is not killed too promptly by the germ and the amount injected is sufficient. Until we have evidence of a much more convincing nature than that given up to date, we believe it is pretty safe to state that these organisms are not the causal agent of the disease.

Heist, Cohen and Kolmer¹⁰⁰ have studied six strains of streptococci, including Rosenow's, Kolmer's, Mathers', and Nuzum's. One of Rosenow's strains was apparently as different from those of the other observers as one type of pneumococci is from another. The strains of the other three observers mentioned were apparently identical. They also studied a number of strains serologically, and found that the serums of a large percentage of persons with poliomyelitis gave high opsonic indices with these streptococci, but not with streptococci from non-poliomyelitic sources, nor with Gram-negative bacilli obtained from poliomyelitic material.

Nuzum,¹⁰⁰ using cultures of the organism isolated from spinal fluids and from the central nervous system of human cases of poliomyelitis, has also produced an antipoliomyelitic serum which contains agglutinins, opsonins and complement-fixing bodies as well as certain antibactericidal properties. The report does not make any comment on the therapeutic value, but Nuzum believes that a potent poliomyelitis antiserum might be of definite therapeutic value. He produced immunity in three sheep, two lambs and four rabbits, using the rapid method of Amoss and Wollstein.

Rosenow, Towne and Wheeler¹⁰² report some observations which clearly indicate that immunity was conferred on three monkeys by inoculations which were not followed by obvious evidence of infection. One of the animals had previously received an intracerebral injection of the pleomorphic streptococci, a second had received it in the central nervous tissue emulsion from animals paralyzed by cultures of the streptococci, and the third had received the virus in the usual way.

Blanton¹⁰³ and Rosenow and Towne¹⁰⁴ have made a study of the presence of bacteria in the nervous tissue. They were able to demonstrate cocci in the exudate over the cerebrum and cerebellum in 1 case, and in a study of a large number of sections of the cord they found some small bodies of variable size occurring in pairs which they thought were cocci.

Larkin¹⁰⁵ has made a study of series of cases and described the microscopic and macroscopic lesions, which need not detain us, inasmuch as nothing definitely new was found. It is interesting to note, however, that he states that sections from the brain, meninges and spinal cord

¹⁰⁰ New York Medical Journal, September 1, 1917, p. 404.

¹⁰¹ Journal of American Medical Association, January 6, 1917, p. 24.

¹⁰² Ibid., January 27, 1917, p. 280.

¹⁰³ Journal of Medical Research, 1917, vol. xxxvi, p. 1.

¹⁰⁴ Ibid., 1917, vol. xxxvi, p. 175.

¹⁰⁵ Archives of Pediatrics, August, 1917, p. 601.

taken at different levels, and appropriately stained for different organisms, gave negative results.

Greely¹⁰⁶ has given an account of the behavior of the organism isolated by Rosenow on solid media, and among other points brings out the fact that this organism grows very well in cows' milk, appearing like a very minute coccus after forty-eight hours of growth. He suggests the possibility of milk being a factor in the spread of the disease, but certainly all observations made during the various epidemics, with one or two possible exceptions, have shown that milk can be pretty well ruled out as a means of transmitting the virus.

Mathers and Tunnicliff¹⁰⁷ have some observations on the opsonic curve in some poliomyelitis cases and believe that their results indicate that a specific opsonin for the poliomyelitis coccus usually appears in the blood during the second week of the disease. They observed no change in the opsonin for the *Streptococcus pyogenes* or *Streptococcus viridans*, and believe that it is specific and bring it forward as additional proof of the coccus being the causative factor in the production of the disease.

Gauss¹⁰⁸ made a study of the cerebrospinal fluid from 50 patients with scarlet fever and some with associated exanthema, as diphtheria and varicella, and was unable to find the micrococcus described by Nuzum. He found that the average cell count for scarlet fever is 0.8 per cm., and the lymphocytes predominate.

Bull¹⁰⁹ has made a study of streptococci cultivated from the tonsils of 32 cases of poliomyelitis, and observations were made on guinea-pigs, dogs, cats, rabbits and monkeys. In no case was anything induced resembling poliomyelitis, either clinically or pathologically, but some of the animals developed lesions ordinarily seen in streptococcus infection. These lesions did not seem to vary in character or frequency from those caused by streptococci from other sources. The monkeys which had recovered from streptococci infection from poliomyelitis did not show any protection from infection with the filtered virus, and their blood did not neutralize the filtered virus *in vitro*. These observations may be taken distinctly against the idea that poliomyelitis is caused by a streptococcus, and it is also a fact that the thousands of cases seen in New York in the summer of 1916, in which there was no instance of metastatic infection and inflammation, such as are ordinarily seen in streptococcus infection.

AFTER-CARE OF POLIOMYELITIS AS A PUBLIC PROBLEM. This subject has been discussed by Lovett,¹¹⁰ who, after extensive study of not only the epidemic of 1916 but a number of others, has come to the conclusion that there are a large number of children afflicted with this disease who are unable to obtain proper after-care. It would seem to be a particularly important thing for the State or municipality

¹⁰⁶ New York Medical Record, January 13, 1917, p. 56.

¹⁰⁷ Journal of American Medical Association, December 23, 1916, p. 1935.

¹⁰⁸ Ibid., March 10, 1917, p. 779.

¹⁰⁹ Journal of Experimental Medicine, April 1, 1917, p. 557.

¹¹⁰ Journal of American Medical Association, February 10, 1917, p. 410.

to get lists of cases that have been affected with the disease and have them followed up to see if proper care and training and treatment are being carried out, for certainly in this way a great many children who might go on and become hopeless, and become public charges because of their helplessness, may be made to be self-supporting. Lovett takes up the question as it applies to both cities and rural communities, and suggests that a traveling, or stationary, unit be established and that this be taken to the affected centers where cases could be seen in consultation with the family physician and the case dealt with through him. Cases could be gone over and subsequently followed up in the homes by skilled muscle trainers, and subsequent clinics could be held in the same place at intervals of three months or more for a period of several years.

Another important method of dealing with these cases is the establishment of children's hospital schools, which has been done in a number of places. These institutions are most useful, inasmuch as they give hospital care and treatment to crippled children and at the same time afford them opportunities for continuing their school work and for vocational training for the older ones, something which is not accomplished in the average hospital.

Another article on the subject of the after-care of paralyzed children is by Lovett,¹¹¹ and anyone desiring a short resumé of his opinions will do well to read it.

FATIGUE AND EXERCISE IN THE TREATMENT OF THE PARALYSIS. Lovett,¹¹² who has done so much in the treatment of the children afflicted with poliomyelitis, has an analysis of 1836 cases, being a study of the records of the poliomyelitis clinics of the New York State Department of Health. The four points particularly emphasized are, (1) that a complete examination of every case gives a different picture as to the general and special distribution of the paralysis from the usual one; (2) that muscular weakness is much more frequent than total paralysis; (3) that a greater degree of paralysis in the legs of old, as contrasted with new, cases suggests that the weight-bearing use of the legs in walking is harmful; (4) that the different functions of the right and left arms may be used for the study of the effect of non-weight-bearing exercises. The muscles were graded as:

1. Normal.
2. Good when the muscle was strong enough to overcome gravity and some resistance, but was not of normal strength.
3. Fair when the muscle was able to overcome gravity and could perform part of the normal movement.
4. Poor when slight movement could be accomplished but gravity could not be overcome.
5. Trace when no movement of the limb could be accomplished, but the muscle could be felt to contract.
6. Totally paralyzed when attempted voluntary movement was not accompanied by a perceptible contraction of the muscle.

¹¹¹ *Journal of American Medical Association*, April 7, 1917, p. 1018.

¹¹² *Ibid.*, July 21, 1917, p. 168.

Lovett also calls attention to the fact that in many of the cases in which the muscles of the abdomen, back or neck are overlooked and are only noticed when the child begins to develop a scoliosis. This should be watched for very carefully after attacks of the disease, and especially if there has been any involvement of the abdominal or back muscles. It is important to note that in a study of 948 cases there were 2352 totally paralyzed muscles, an average of two and a half paralyzed muscles per individual, while in 375 old cases there were 1622 totally paralyzed muscles, an average of four and a third totally paralyzed muscles per individual. Another feature was that the total paralysis in the leg in the order in which they occurred was the posterior tibial, the two extensors, the peronei, the gastrocnemius, hamstrings and quadriceps, with a smaller number of total paralysis in the hip. There is not much material difference in this in the new or in the old cases, but the amount of total paralysis is, as above mentioned, greater in the old cases. Lovett accounts for the difference in the frequency of the total and partial paralysis in the recent and the old cases in one of two ways. Either the partial paralysis may clear up in the years following the attack, and so leaving a larger proportion of the total paralysis in these old cases, or that partial paralysis becomes total paralysis in the course of years. The first inference does not coincide with facts, inasmuch as there is an absolute and relative increase in the total paralysis in the old cases as contrasted with the new ones; but if the partial paralysis becomes total eventually the total paralysis would become relatively and actually more common in the old cases, and the proportion of total to partial paralysis would become higher in the old than in the new, which is what apparently happens. The most natural explanation of why the partial paralysis should change to total is that the muscles have to carry weight and are overused and fatigued and hence they have a total loss of power as a result. Lovett makes the following very important statement: "Whatever may be said in its favor, walking on the muscle which is reduced to 30 or 40 per cent. of its normal power is a very serious tax on that muscle's endurance, and however much one may be a believer in exercise the use of such muscles for weight-bearing or walking is not desirable from what we know of the physiology of muscles. These data taken together bear out a perfectly clear conviction on my part, already definitely expressed, that walking to any extent with or without braces in the first year after an attack of infantile paralysis not only tends to delay the improvement of partly paralyzed muscles and is liable to set a limit to their final restoration, but may also change them from the class of partly paralyzed to totally paralyzed muscles."

Ebright¹¹³ has given his experience in the treatment of 146 cases of seriously paralyzed children and lays particular stress upon the fact that a stretched muscle will not regain its tone. He believes that many of the muscles marked as badly involved on admission have been found to be a loss of power due to fatigue rather than to be actually paralyzed,

¹¹³ Journal of American Medical Association, September 1, 1917, p. 694.

and after putting the leg up in plaster for two or three weeks the anterior and posterior tibial muscles are found to be in very good condition. In place of trying to get the children up as soon as possible he has followed the opposite course of allowing the child to be in bed to allow a symmetrically recovered whole. He does not believe if a child is properly massaged and has muscle-training that the prolonged rest in bed does any harm. Another important point is better results are obtained either at home or in a hospital than in having the children come to the dispensary, inasmuch as the moving about causes casts to break and the braces to slip, besides the supports will need frequent readjusting even with the most careful attention. In company with most other observers he does not believe that electricity has much place in the therapeutics of the disease.

Boorstein¹¹⁴ agrees with this statement regarding electricity and believes in the use of proper braces, but also that they should be discontinued as early as possible. He expresses the contrary opinions stating that the quicker children begin to walk the quicker they improve, provided, of course, they do not use the legs excessively.

Ogilvy¹¹⁵ has also made a short report on 110 cases, and emphasizes the importance of continuous supervision and the value of bath exercises, and he also comments on the value of testing the muscles by balanced weights, which he believes to have decided value.

Jahss¹¹⁶ has also made a study of 400 cases seen at the clinic of the Hospital for Deformities and Joint Diseases in New York, and calls particular attention to the fact, as has everyone who has had anything to do with this disease, of the extreme importance of avoiding early deformities.

THE TREATMENT OF DEFORMITIES OF THE SPINE. Hibbs¹¹⁷ gives the details of 8 cases of scoliosis, doing what is called the fusion operation similar to that which is performed on patients with Pott's disease. This operation produces a fusion of the bones of the spine, and, in carefully selected cases, seems to give very excellent results.

SERUM THERAPY. The basis for using a serum in this disease rests primarily on the fact that Flexner and Lewis, in 1910, demonstrated that monkeys which had had the disease and recovered could not be reinoculated. This was confirmed by other investigators. Subsequently, Römer and Joseph demonstrated that there were immune bodies in the blood of such monkeys which would neutralize the virus when mixed with it in a test-tube, and Levaditi and Netter, and also Flexner and Lewis, showed that the same was true with the blood from human beings who had recovered from an attack. Flexner and Lewis, after this, demonstrated that monkeys which were actively immunized showed the presence of the same immune bodies. Flexner and Lewis then demonstrated that the serum from monkeys or from individuals who had had the disease, inoculated into animals with the virus, even from eighteen to twenty-four hours afterward and repeated during several

¹¹⁴ Journal of American Medical Association, September 1, 1917, p. 696.

¹¹⁵ Ibid., p. 691.

¹¹⁶ Ibid., March 10, 1917, p. 754.

¹¹⁷ Ibid., September 8, 1917, p. 787.

days, would either inhibit development of the disease or limit its ravages if it developed at all. The disease could be prevented by the subdural injection of the serum, either after the injection of the virus into the blood or directly into the meninges. In the monkey, the first symptoms of the disease are only from ten to twenty hours before the beginning of the paralysis, and this usually occurs from six to seven days after the inoculation. Fortunately, in man, the disease does not develop quite as promptly, and the preparalytic stage is ordinarily from two to four days. The first observations on using this serum in man were made by Netter¹¹⁸ and Salanier¹¹⁹ and Netter.¹²⁰ The serum was taken from individuals who had had paralysis, and even thirty years after an attack the immune bodies may still be demonstrated. Where it was possible, however, they preferred cases in which the paralysis was of not more than five years' standing. The individuals were carefully examined and the blood controlled by a Wassermann reaction. The introduction of human serum into the spinal canal was generally very well tolerated, but it causes an inflammatory reaction of the meninges, as is shown by specimens of the fluid drawn after subsequent puncture, the fluid at this time being cloudy and containing fibrin. The albumin is increased and the number of cells also increases, the polymorphonuclear cells predominating. Sometimes this fluid will produce a yellowish clot and many times there are no symptoms of any change going on, but occasionally there may be pain along the spine, with stiffness of the neck and body and a slight elevation of temperature. Only twice in 32 cases was there any alarm caused by the injection of the serum. Netter, in his 32 cases, had 6 complete and rapid cures, 3 cases so much improved as to approach a perfect cure, 7 were markedly benefited, and 5 appreciably so, but in these the influence of the serum was doubtful. In 3 cases the course of the disease was not modified, and 8 patients died, 7 from bulbar paralysis.

Netter believes that the serum is capable of stopping the course of the paralysis, or even causing it to disappear if already started. He thinks that if it is given in the preparalytic stage, it may prevent the occurrence of the paralysis. The serum should be used within the first four days to be efficacious, as after that he does not expect any real benefit. In one instance they did inject the serum in the preparalytic stage and there was no subsequent paralysis.

The reports of the use of the serum during the past year have not yet been made public, so that one cannot say definitely what values it has. In New York City¹²¹ a very considerable number of cases have been treated, either with fresh serum or that prepared with 0.2 per cent. tricresol, and passed through a Berkefeld filter. From 10 to 15 c.c. were injected intraspinally after the removal of a somewhat larger amount of spinal fluid, and this dose was repeated every twenty to twenty-four hours until two or three doses were injected. The administration of

¹¹⁸ Bulletin de l'Académie de médecine, October 12, 1915.

¹¹⁹ Bulletin et mémoires société médicale des hôpitaux de Paris, March 23, 1916, p. 299.

¹²⁰ Archives de Médecine des Enfants, January, 1916, p. 1.

¹²¹ Weekly Bulletin of Department of Health of the City of New York, October 28, 1916, p. 345.

the serum is followed with a slight increase in the irritative symptoms, but this is usually less marked when the serum is given late than if it is given in the early stages. The spinal fluid showed a marked increase in the polynuclear cells. Favorable results seemed to have resulted when the serum was used in the preparalytic stage of the disease and there seems to be an opinion that the mortality was probably favorably influenced. In the later cases, in which there seemed to be danger of the involvement of the muscles of respiration, in a certain proportion the serum seemed to have an inhibiting, and possibly a lifesaving, effect. The results justify the use of serum when it can be obtained, but personal communications from several of those who have used it seem to show that they are not as enthusiastic as they were at first.

Wells¹²² seems to be favorably impressed with the value of the serum after using it in 15 cases.

Sophian¹²³ believes that the inflammatory reaction of the meninges and nerve substance is best treated by intraspinal injection of serum, either normal human serum, normal horse serum or convalescent serum. Both normal horse serum and normal human serum can easily be procured, and, if sterile and properly injected, are harmless. In order to avoid sensitization to a foreign protein, it seems preferable to use human serum. This, when injected into the spinal canal, seems to cause a hyperleukocytosis which he believes to be of very definite value. He used this method with horse serum on a series of 10 patients, mostly cases admitted late, and believes that, in the few cases in which it was used early, some definite improvement was noted. The changes in the cerebrospinal fluid after the injection of the serum consist in a definite increase in the polynuclear cells and a very high cell-count within eighteen hours, quite striking from the number of lymphocytes usually seen. Twenty-four hours after the injection the fluid becomes faintly opalescent, occasionally turbid, but examination shows a sterile fluid like that seen in septic meningitis. He also treated a small series of 10 cases with serum from convalescent patients, and in some he thought he obtained favorable results, but not better than in those cases in which normal horse serum was used.

Flexner and Amoss¹²⁴ have shown that the cerebrospinal fluid taken very early and quite late exhibits no neutralizing action on poliomyelitic virus, and, indeed, its neutralizing principles have only been found very exceptionally in the cerebrospinal fluid. They have also shown that the immune bodies may be present in the blood as early as the sixth day of the disease, and that the injection of sterile horse serum into the meninges in monkeys increases their permeability, and this permits the immunity principles injected into the blood to pass into the cerebrospinal fluid. In monkeys that have been given injections of immune blood, the passage into the cerebrospinal fluid takes place during a rather short space of time, and apparently only while the inflammatory reaction produced by the horse serum is at its height. Normal serum injected intraspinally

¹²² *Journal of American Medical Association*, October 26, 1916, p. 1211.

¹²³ *Ibid.*, August 5, 1916, p. 426.

¹²⁴ *Journal of Experimental Medicine*, April 1, 1917, p. 499.

into monkeys apparently does not exert any curative action. Inasmuch as the immunity principles appear in the blood only after several days, the employment of normal horse serum, which seems to act, if it has any action, through increasing the permeability of the meninges, permitting the escape of circulating immunity principles in the blood; but as these are not present during the first few days of the illness, it would seem decidedly preferable to use an immune serum.

An Antipoliomyelitis Horse Serum. In 1910 Flexner¹²⁵ attempted to produce an antipoliomyelitis horse serum, but after treating a single horse for many months did not find any immune bodies that had any restraining effect on the virus, either *in vitro* or within the body. We do not know of any other observations of this kind except those of Neustaedter and Banzhaf¹²⁶ who report the results of observations made in the Research Laboratory of the Department of Health of New York City. Any work done under Dr. William H. Park, director of the laboratory, is worthy of most careful consideration. It seems that the destructive action of the virus is probably not due to an exotoxin but to the ability of the virus to multiply rapidly. They therefore thought it advisable to see if the horse would react to an endotoxin, and since Flexner obtained no results by using large amounts of the filtrates of the active virus, and exotoxins and endotoxins cannot be produced by the Flexner and Noguchi methods of culture, the authors in question attempted to obtain an endotoxin by digesting the germ in the filtrate of a brain and cord emulsion of trypsin in 10 per cent. glycerin solution. The endotoxin could not be demonstrated, but at the end of August they started to prepare it, and early in September started to inject it into a horse. Five different injections were made, ending in November, and two weeks later the horse was bled and the serum prepared. Five neutralization experiments were made on monkeys, all of which were positive. On account of the scarcity of monkeys, not as many observations were made as would otherwise have been done, but the authors feel that their results justify the use of the serum in human cases, especially if human serum is unobtainable.

Following is the protocol of their first observation:

Observation 1. December 6, 1916, monkey 3 (mangabey) was injected intracerebrally with 0.5 c.c. of a 5 per cent. suspension of an eighth generation monkey virus and at the same time 20 c.c. of the serum intramuscularly. Twenty-four hours later, daily injections were begun of 3 c.c. of the serum intraspinally and 17 c.c. intramuscularly. These were given for seven days, when it was considered wise to cease treatment. The animal remained well up to December 17, four days after the last treatment, when it seemed ill at ease. On December 18 the right extensor cruris was weak. On this day he received 3 c.c. of the serum intraspinally and 17 c.c. intramuscularly. On December 19 he seemed to favor the left leg also. On this day and the following he received 3 c.c. of the serum intraspinally and 17 c.c. subcutaneously. The animal began to improve in the afternoon of December 19, and on January 7

¹²⁵ Journal of American Medical Association, September 24, 1910, p. 1112.

¹²⁶ Ibid., May 26, 1917, p. 1531.

was completely well and continues well today, four months after the inoculation.

Control. On the same day monkey 2 (*Macacus rhesus*) was injected intracerebrally with 0.5 c.c. of the same suspension of the same virus. This animal died in convulsions within six days and six hours. Histopathological lesions were characteristic of poliomyelitis.

Rosenow's Antipoliomyelitis Serum in Horses. Using the organism which he has isolated, which is a pleomorphic streptococcus or micrococcus, and following the method for immunizing horses worked out by Flexner and Amoss, and Amoss and Wollstein, Rosenow¹²⁷ has produced a serum. The organisms were derived from poliomyelitis in man and from experimental poliomyelitis in the monkey. The serum showed the presence of specific antibodies, agglutinins, and had complement-deviating properties, and the agglutinins were apparently present in a very large amount. This serum, according to Rosenow, has a neutralizing, protective and curative power against the virus of poliomyelitis.

The serum of the horse immunized by the streptococci appeared to Rosenow¹²⁸ to have some curative effect in the experimental disease in monkeys after the symptoms had started. In an epidemic at Davenport, Iowa, the serum was used on a certain number of cases. The serum is activated by complement by adding 1 part fresh guinea-pig serum to 9 parts of the immune serum and incubating it at 37° for one hour, after which it was diluted with an equal amount of 0.85 per cent. salt solution. It should be used within thirty-six hours after activation. The serum was injected into the superficial vein very slowly, about 2 c.c. per minute, and various doses were given according to the age of the patient and the severity of the disease. From one to two years of age 3 to 7 c.c. at a dose, that is, 6 to 14 c.c. of the mixture; from two to five years of age, 7 to 10 c.c.; and older than this from 10 to 20 c.c. Injections were repeated in from eight to twenty-four hours.

Forty-four patients were treated, 9 of whom died, a mortality of 20 per cent. Six of these were moribund at the time the serum was given; excluding these from the figures, it gives a mortality of 8 per cent. During the same epidemic, 23 untreated cases had a mortality of 35 per cent. According to the preliminary reports, the symptoms disappear soon after the injection and the temperature and pulse rate lowered, and the note is made that the beginning paralysis often disappears in an astonishing short space of time and that progressive paralysis is often arrested and improvement is unusually rapid. The patients treated seemed to have less pain than those in which the serum was not used.

Nuzum and Willy¹²⁹ have also prepared a horse serum after the method described by Amoss and Wollstein,¹³⁰ using what they call the poliomyelitic coccus isolated from the brain and cord of two recent human

¹²⁷ *Journal of American Medical Association*, July 28, 1917, p. 261.

¹²⁸ *Ibid.*, September 29, 1917, p. 1074.

¹²⁹ *Ibid.*, October 13, 1917, p. 1247.

¹³⁰ *Journal of Experimental Medicine*, vol. xxiii, p. 403.

cases. They treated 159 patients in all stages of the disease, 19 of whom died, or a mortality of 11.9 per cent. In 100 cases occurring at the same time, in which the patients did not receive treatment, 38 patients died, or a mortality of 38 per cent. Excluding 7 cases, which were admitted to the hospital with respiratory paralysis, reduces the number of deaths to 11, or a mortality of 7.2 per cent. in 152 cases treated. During the same period of time a total of 301 cases were reported to the Health Department, with 97 deaths, a mortality of 32 per cent. The authors claim that the series of patients treated is sufficient to demonstrate the harmlessness of the serum when the serum is free from hemoglobin, sterile to repeated cultures, the injections are slowly made, and all the rules of precaution are carefully observed. They believe that if the serum is used sufficiently early it has a definite power in preventing the onset of paralysis. In 10 cases of poliomyelitis in which no paralysis was detected, in which the serum was administered, all recovered without any paralysis. They also believe that the action of the serum is more definite in arresting the extension of the paralysis and diminishing the severity than in effecting its disappearance. They believe that the serum should be injected intraspinally in small doses and at the same time intravenously in large doses; they have used the temperature as a guide to the amount to be given. Following the injection of the serum, there is a critical fall in the patient's temperature, a slowing of the pulse and general improvement of the patient.

Unless one were more or less familiar with the history of reports from previous therapeutic measures in various diseases, they would at once conclude that a specific treatment of great value had been discovered. It is to be hoped that valuable observations along the same line by other observers will confirm the above observations. Until this has been done, however, one would not like to pass upon the value of this serum. It is possible that the serum may have some effect upon the cocci that seem to be a pretty general accompaniment of poliomyelitis, perhaps much as streptococci are seen in cases of scarlet fever. It would be interesting to know if these, or similar organisms could be isolated from patients dying with other diseases, particularly if the observations were made by the investigators who have been working with these organisms, and who are therefore familiar with them.

Summary of Serum Treatment. Immune serum, normal human serum, or sterile horse serum may be used. The exact value of these cannot be stated at the present time. We believe, however, that one is justified in doubting both the efficacy or the advisability of the use of horse serum or of normal human serum. From the evidence at hand we do not believe that the immune serum, as used at present, will be found to be of any value in the frankly paralyzed cases, certainly not unless used at the onset of the loss of power. In progressive cases and those with threatened respiratory involvement, the serum might be tried. In the preparalytic cases the results seem more encouraging, but until larger series of treated and non-treated cases are compared,

it is impossible to say more at this time. If a definite diagnosis has been made and the serum is at hand, we advise its use, but would not consider the failure to use it as a serious omission in the treatment. Antipoliomyelitic horse serum may be used in place of the human serum if available. (See same.) Rosenow's serum must also be considered as yet only in the observational stage.

Method of Preparing Human Immune Serum. The following is the method used by the workers of the New York Health Department during the epidemic of 1916, and the technic is taken from their report:

To obtain the immune serum the blood is drawn from suitable donors in quantities varying with the age and the apparent hemoglobin content of the individual. On the average it is said to withdraw 2 ounces from children nine to ten years of age, 3 to 4 ounces from children twelve to thirteen years of age, 4 to 6 ounces from individuals eighteen years of age and over. Adults, especially the robust, full-blooded kind, average 10 to 16 ounces of blood. Similar amounts can be withdrawn again after an interval of two or three weeks. The blood is best withdrawn by using a 15-gauge platinum or steel needle. In children and stout persons with small, or indistinct, veins, a 17-gauge needle attached to a 1-ounce Record syringe may be satisfactory. The blood is collected in small glass bottles in quantities of 1 or 2 ounces and given a long slant, so as to obtain as long a surface for the serum as possible. The blood is allowed to cool and the bottles are placed in the ice-box during the first twenty-four hours to allow the separation of the serum. This is decanted the following day and centrifugalized to free it from pieces of blood clot and red blood cells. To the serum is added 0.2 per cent. of tricesol. This increases the local irritant action of the serum, and it may be found advisable not to add it; 25 per cent. of tricesol in quantities of 4 c.c. to over 500 c.c. of serum gives the required strength. The serum is then allowed to stay in the ice-box forty-eight hours, during which time there is a precipitation of a fine cloud that appears after the addition of the tricesol. After this is separated, the serum is removed from it. The serum is then passed through a Berkefeld stone filter in quantities of 15 c.c. and kept cold in dark amber or blue bottles in the ice-box.

Duration and Efficiency of the Serum. If the serum has been preserved with tricesol or handled with sterile precautions after it has been passed through a Berkefeld filter, and it is afterward kept in a cold place, it will probably remain efficient in its specific content for several weeks. The serum obtained during the New York epidemic of 1916 was used up almost as fast as it was obtained. Some kept four to six weeks, however, seemed as active, therapeutically, as the more recently drawn. In an emergency, or when the facilities for treating with serum are not obtainable, blood may be simply drawn under aseptic conditions in a vessel with glass beads, shaken up and centrifugalized, or the serum may be drawn in the usual way and allowed to separate for a few hours and promptly used, disregarding the presence of a few red blood cells. The serum probably owes its action (1) to the presence of specific immune bodies, and (2) to its action as

normal human serum as such. The serum should not be heated. The donors should be free from syphilis, as demonstrated by a negative Wassermann reaction, and it should be definitely ascertained that the person has actually had poliomyelitis and not a Bell's palsy or syphilitic paralysis, an ordinary hemiplegia or tuberculosis of the joints.

Pneumonia. PNEUMONIA IN CHILDREN. Koplik¹³¹ has an interesting article on this subject which he has considered from a number of different stand-points. He believes that the results obtained in a modern up-to-date hospital are better than those obtained either in tenement houses or in the better class of private practice. Of the complications that were encountered, ileocolitis is the most frequent, and the next most serious complication is meningitis. When accompanying a pneumonia, occurring during the first year, meningitis is invariably fatal, and it occurs more frequently at this age than in later childhood. A very misleading complication is meningismus, which may simulate meningitis to a very remarkable degree, so that without a lumbar puncture definite diagnosis is impossible. Empyema is another complication of considerable moment.

The breast-fed babies, as might be expected, have a better chance than the bottle-fed baby, providing it is in good condition before the pneumonia takes place; but Koplik believes that a successfully bottle-fed infant has as good a prognosis as a successfully breast-fed infant.

Koplik does not believe in using very many drugs, placing his chief dependence, like all other good practitioners, on maintaining the strength of the patient by proper nursing and feeding. A high temperature has been combated by hydrotherapy, particularly when there is an irritable nervous system. The author also warns against giving nauseating drugs, and believes that when heart stimulants or other medicants are needed it is better to use them hypodermically. Camphorated oil and caffeine he regards as among the best cardiac stimulants; also the tincture of digitalis. In cases having tachycardia, with threatened break-down of the heart and enlargement of the liver, digipuratum, given intravenously in full doses twice in twenty-four hours is used. As regards the use of alcohol, Koplik has discarded it in the treatment of pneumonia, and results in his hospital have been as good without the addition of whisky as with it. This question of the use of alcohol in pneumonia is a very interesting one. In former days, when whisky was used as a routine in pneumonia, it probably did more harm than good, but I believe that in certain carefully selected cases, particularly children with severe nutritional disturbances or extreme toxemia, the judicious use of whisky properly diluted is of great service. One may condemn the giving of digitalis to all patients without reference to its need, or camphorated oil or any other drug. Without having tried it, there is no doubt in my mind that taking a series of 500 pneumonias with the free use of any drug in all cases, and 500 cases without it, the end-results would certainly be more favorable

¹³¹ Journal of American Medical Association, November 17, 1917, p. 1661.

in those that were not indiscriminately drugged than in those who were, and I also believe that taking a third 500 cases with intelligent supervision of the use of heart stimulants and such other needs as might be necessary, the results would be still better.

Koplik very properly warns against the use of too much cold air in the treatment of the pneumonias of young children. He states that the air in the sick room should be fresh and crisp, but not icy cold. In some instances pale infants exposed to cold air becomes blue while ruddy infants may become pale. Koplik has adopted the plan of giving fresh cold air at a temperature which is not uncomfortable to the nurse.

PULMONARY EDEMA IN PNEUMONIA. Bastedo¹³² has studied this subject and calls attention to the fact that the factors favoring increased production of tissue fluid are increased intracapillary pressure, increased permeability of the capillary wall, which may result from changes produced by circulating poisons, local irritants, or lack of oxygen or nutritive material, and hydremia when there is an excess of water in the blood, if accompanied by plethora, as after large intravenous infusion of physiological salt solution. The factors which favor the removal of the tissue fluid are lymph stagnation, diminished capillary absorption, and increased molecular concentration of the tissues, so that they have an increased osmotic pressure and take up more fluid than normally, or hold the fluid more firmly.

The *treatment* of the condition must aim to lessen the production and increase the removal of the fluid. Cardiac failure must be combated by the use of *digitalis* or, better, as Bastedo believes, by the use of *strophanthin*, 0.5 mg. ($\frac{1}{30}$ grain) given intravenously, usually acting in an hour or less. If no result is obtained from the first dose, it may be repeated in two hours. If *digitalis* has already been given, the intravenous dose should not exceed 0.3 mg. ($\frac{1}{200}$ grain). He does not use camphor, strychnine or caffeine in cardiac failure, nor does he believe in the use of nitroglycerin.

Venesection is one of the most reliable procedures in the pulmonary edema of pneumonia, lessening the systemic venous congestion and the plethora which exist in a stagnant circulation and relieving the venous end of the heart so that the heart beats more effectively. In respiratory insufficiency, atropine, caffeine and strychnine may be considered, as well as inhalation of oxygen for artificial respiration and of counter-irritation. Bastedo does not believe that atropine is of much value in this condition, that it has decided disadvantages, one of them being that through the vagus action it abolishes any action of *digitalis* or *strophanthin* upon the auriculoventricular conduction tissues, and completely neutralizes the effect of *digitalis* or *strophanthin* in steadying the work of the left ventricle.

Caffeine he believes to have a definite value in an emergency, but is not to be used as a routine measure, as it interferes with sleep. He believes that strychnine is too weak a cardiac stimulant to be of use,

¹³² Journal of American Medical Association, September 8, 1917, p. 800.

but that it may be of use in inducing a general increase of reflex activity, but, if the reflexes are already overacting, the drug is contra-indicated.

The *inhalation of oxygen* and the use of *artificial respiration* is of value. The relief of pressure of gas in the abdomen may be accomplished by a hypodermic of pituitary extract or by some of the other methods of relieving tympanites, but gastric lavage is impossible or, if not, exceedingly dangerous. If the patient's side has been strapped on account of pleurisy, the strapping should be removed to allow freer motion. He also recommends that the head be lowered, so that the fluid gravitates from the lungs, this procedure being of value in the edema occurring from pilocarpine and anesthetics, and it may also be of service in those occurring in pneumonia.

Various forms of counter-irritation have been used, of which Bastedo prefers dry cupping. He also warns against the use of morphine on account of its depressing the respiration, and against the use of sodium bicarbonate solutions, either by rectum or intravenously; except when urgently indicated a hypertonic 10 per cent. solution in amounts of 400 c.c. may be used. There is, however, no contra-indication to the use of bicarbonate by mouth.

ACIDOSIS AND ACID EXCRETION IN PNEUMONIA. There has been an opinion, based on a certain amount of evidence, that during the febrile period of pneumonia there is considerable increase in the amount of acid formed in the body. The ammonia-nitrogen in the urine is increased, and the excretion of acid in the urine has also been noted, and Palmer and Henderson have observed that during the height of the disease larger amounts of sodium bicarbonate by mouth were necessary to reduce the acidity than would be needed in the normal individual. Peabody and other observers, have found that the carbon dioxide pressure in the blood is diminished, and Lewis found that the blood of pneumonia patients had a decreased affinity for oxygen. Palmer¹³³ found that the urine of pneumonia patients contains a large amount of organic acid which is free as a hydrogen-ion concentration of 5. The acidosis, as determined by the combined carbon dioxide in the plasma, is seldom, if ever, severe.

LUMBAR PUNCTURE FOR THE RELIEF OF DELIRIUM IN PNEUMONIA. Musser and Hufford¹³⁴ have made a short report on the use of lumbar puncture for this purpose. A couple of years ago Roger and Baumel suggested this for the relief of headache in pneumonia. Schottmüller and Schumm had previously shown that there is a marked increase in the intraspinal pressure in delirium tremens, and Steineback has used lumbar puncture with excellent results in this affection.

Seven cases of severe delirium associated with lobar pneumonia were treated by lumbar puncture, and in each instance the delirium was promptly relieved. This measure is apparently only of value in relieving a severe symptom and does not seem to have any curative value. Delirium is usually an indication of a very severe affection and in such cases

¹³³ Journal of Experimental Medicine, 1917, vol. xxvi, p. 495.

¹³⁴ Journal of American Medical Association, April 28, 1917, p. 1231.

the mortality rate is very high, as evidenced by the 4 fatal outcomes in the series reported by the authors.

THE SKIN REACTIONS IN PNEUMONIA. These have been studied by Clough,¹³⁵ and, more recently, by Steinfield and Kolmer.¹³⁶ Clough, using cutaneous, ophthalmic and intracutaneous tests with extracts of pneumococci, was unable to demonstrate a condition of hypersensitiveness to pneumococcus protein in patients with pneumonia. Weil¹³⁷ found, by using an autolyzed extract and injecting it into the skin, that there were no reactions during the course of the disease, but that after it was over the reaction could be obtained in a considerable percentage. Steinfield and Kolmer tried the intradermal reactions, with extracts from types 1, 2, and 3, on patients with lobar pneumonia, both before and after the crisis, on patients in whom the type of pneumococci had been determined, also in healthy individuals and certain persons suffering with various chronic infections other than those of the respiratory system. The material for the tests, which they have termed anaphylactogens, was made from pure cultures grown in dextrose broth for forty-eight hours and then washed with sterile salt solution, centrifugalized, and suspended in sterile salt solution sufficient to make about 2,000,000,000 cocci to the cubic centimeter. This was then heated at 60° C. for one hour and preserved with 0.2 per cent. tricresol.

In making the test, 0.1 c.c. was injected intracutaneously. The three injections were made at one time in each patient. After the first twenty-four hours, most persons, both controls and those suffering with pneumonia, showed a narrow zone of hyperemia. Reactions were read forty-eight hours after the injection and those that showed an area of erythema of over 1 c.c. in diameter were regarded as positive, but, when the area was less than this and disappeared in seventy-two hours, the reaction was regarded as due to possible irritation or as a negative reaction. In the positive reactions there was the formation of the positive papule and slight edema, and these reactions persisted for from four to five days. There was no suppuration in any instance, and no disturbance beyond a slight burning pain which came on within a few hours after the injection.

Reactions were noted in 30 per cent., and true reactions were not seen in normal individuals or those suffering with other diseases, and the presence of pneumococci in the upper air passages during health produced no sensitization and no reaction. The reactions all occurred after the crisis or after the infection had been present for a long period of time, and curiously enough, there was no constant relation between the reaction to the various types of the pneumococcus and the types found in the sputum from which the authors deduced that the reactions to the pneumococcus protein are of more general character than the agglutination reactions.

GERMICIDES AND PNEUMOCOCCI. *Ethylhydrocuprein.* For many years the fact that quinine possesses some antiseptic and bactericidal proper-

¹³⁵ Bulletin of Johns Hopkins Hospital, 1915, vol. xxvi, p. 37.

¹³⁶ Journal of Infectious Diseases, 1917, vol. xx, p. 343.

¹³⁷ Journal of Experimental Medicine, 1916, vol. xxiii, p. 1.

ties has been well known, and there has also been for a long time an idea, supported by many excellent clinicians, that the drug given in sufficiently large quantities and sufficiently early will arrest an attack of pneumonia. Various preparations of the drug have been suggested, including quinine and urea hydrochloride, and, more recently, ethylhydrocuprein.

Solis-Cohen, Kolmer and Heist¹³⁸ have made a study of certain cinchona derivatives, using the various methods *in vitro* and have found that quinine, hydroquinine or methylhydrocuprein, optochin or ethylhydrocuprein, and their salts exert a very marked bactericidal action on pneumococci. Of these by far the most powerful is ethylhydrocuprein. In a general way the bactericidal action is about the same for all types of pneumococci, although in several instances type 3 (*Pneumococcus mucosus*) was found to be more resistant than the other types studied. They also have reported¹³⁹ in detail the results of their observations on the use of some of the above-mentioned drugs as used in mice and rabbits. They found that ethylhydrocuprein hydrochloride was slightly more toxic for mice and rabbits than the other cinchona derivatives, and that, as a general rule, mice were found to be more resistant to this than rabbits, and young rabbits more so than the older and heavier ones. They determined the lethal dose, both in mice and rabbits, and determined that quinine and urea hydrochloride possess a lesser degree of protective power than ethylhydrocuprein hydrochloride, and also that intramuscular administration affords less protection against the pneumococci than when administered intravenously. The combination of ethylhydrocuprein hydrochloride and other quinine compounds at the same time offers less protection than when used alone. It must be borne in mind that pneumococcus infection in mice and rabbits differs very greatly from the pneumonias of man, and this must be taken into account in considering the use of these drugs in human beings.

The influence of quinine and urea hydrochloride, ethylhydrocuprein and other cinchona compounds on phagocytosis has been studied by Kolmer, Solis-Cohen and Steinfield.¹⁴⁰ They found that these drugs in high dilutions accelerated the phagocytosis of pneumococci by rabbit leukocytes, whereas low dilutions retarded the phagocytosis.

Very probably part of the curative effect of these agents in human infections is due to their influence on phagocytosis, and the same observers have noted that the total number of leukocytes in the peripheral blood of rats may be increased by injection of these agents intramuscularly, and that somewhat lesser degrees of leukocytosis follow the intravenous injection.

Moore and Chesney¹⁴¹ have made a study of the action of ethylhydrocuprein on cultures of the pneumococcus and have used the drug by mouth in a series of 32 cases of acute lobar pneumonia. The dosage was such that the patient received at least 0.024 gram per kilogram of body weight per twenty-four hours, and, when the size and spacing of the

¹³⁸ Journal of Infectious Diseases, 1917, vol. xx, p. 272.

¹³⁹ Ibid., p. 313.

¹⁴⁰ Ibid., p. 333.

¹⁴¹ Archives of Internal Medicine, 1917, vol. xix, p. 611.

individual doses were adequately regulated, a specific pneumococcal action appeared in the blood within a few hours and could be maintained more or less constant for several days. They used three methods of dosage, which, for the sake of brevity, they call A, B, and C. Dose A consisted of four doses of 0.5 gm. or 0.45 gm. each, given at regular intervals in the first twenty-four hours, followed in the second twenty-four hours by one dose of 0.45 gm. and seven of 0.15 gm. at regular intervals; thereafter nine or ten doses of 0.15 gm. in every twenty-four hours.

Dosage B consisted of 10 doses of 0.15 gm. each, given at regular intervals in every twenty-four hours.

Dosage C consisted, in patients of average size, of a single initial dose of 0.45 gm. followed at regular intervals by single doses of 0.15 gm. each, the total amount given in the twenty-four hours being the same for all periods of twenty-four hours, namely, 1.5 gm. Patients below average size received proportionately less. The first method of dosage permits of the occurrence of fluctuations in the concentration of the drug in the blood of the patient, which they found to be undesirable. The method of giving small equal doses at regular intervals from the onset, or dosage B, maintains a constant level with concentration of the drug in the blood, but in order to secure a more rapid appearance of the bactericidal action, or at least to avoid such fluctuations as were obtained under dosage A, the third method was used, or dosage C, which consisted of a large initial dose followed at regular intervals by smaller equal ones. In order to maintain the constant level the space between the doses should ordinarily not exceed two and a half or three hours. There is some evidence that when given by this method there is some retention or accumulation in the blood.

From such evidence as the authors have at hand it seems that the administration by mouth is more satisfactory than the intramuscular administration. It is interesting to note that pneumococci not only *in vitro*, but in the human body of patients treated with ethylhydrocuprein, may acquire more or less complete resistance to the drug, similar to that noticed to quinine in malaria and in the action of other bactericides on specific organisms. Toxic symptoms may result in human beings from the use of the drug, but, fortunately, these are only transient. The most common are tinnitus, deafness and amblyopia or amaurosis; but retinitis, with more or less permanent impairment of vision, may occur, a point which should be borne in mind in considering this drug as a curative measure.

The number of cases treated is too small from which to draw any definite conclusions. In all, 32 were treated. One was excluded because other therapeutic measures were employed, one unclassified case recovered; in 7 others, 3 of which recovered and 4 died, the treatment for one reason or another, was regarded as certainly inadequate. In the remaining 23 cases the majority were due to type 2 or 3, the most virulent of all, and the calculated mortality rate could be regarded as 33 per cent., whereas the actual mortality was found to be 19 per cent., a pretty definite gain.

There is a possibility of getting good results with the simultaneous use of the drug and the antipneumococcus serum, as Cole has reported results that were encouraging when the disease was due to pneumococcus of group one.

EPIDEMIOLOGY OF LOBAR PNEUMONIA. Stillman¹⁴² has made a study of this subject, previous studies having shown that while pneumococci are present in the mouths of normal individuals it is extremely rare to find types I or II in normal persons, except those who have been associated with patients suffering with lobar pneumonia due to organisms of this type. Dochez and Avery have suggested that in many instances lobar pneumonia may be due to contact infection, the source of the infection being either an individual who has recovered from the disease and who still carries the organism in his mouth, or the healthy carrier who has acquired the organism from association with a case of lobar pneumonia. Stillman made a study of the organisms isolated in cases admitted to the Rockefeller Institute, as well as a study of varieties found in the mouths of normal individuals and from the mouths of members of households where cases of types I and II have occurred. He also studied the dust of rooms in which no case of pneumonia was known to have occurred and compared it with the dust from homes where types I or II have been present; and he also had an opportunity of making observations in two epidemics of pneumonia. His observations in regard to the fact that types I and II were responsible for most cases of lobar pneumonia bear out previous studies of others. In the mouths of healthy individuals type IV predominates, type III is frequent and atypical organisms of type II were occasionally found. He also found that healthy individuals who were intimately associated with cases of lobar pneumonia may have types I or II in their mouth secretions. He also found that types I or II was present in the mouth of an individual in a home in which it was impossible to trace any contact with an infected patient. The dust of homes where cases of pneumonia due to types I and II have occurred showed the presence of the same type of pneumococci as infected the patient. He also recovered type I from the dust of a dormitory in which there had been a small epidemic of pneumonia, partly due to type I organism, and somewhat similar observations were made in a second epidemic. From 62 specimens of dust from rooms in which pneumonia had not occurred, in 18, or 29 per cent., the pneumococci was recovered. In all but one instance the organisms belonged to the type of those normally found in the mouth. The specimen of dust from which type I pneumococcus came was from a house where a known carrier of the type I pneumococcus was visiting.

This study points out the fact that lobar pneumonia is a definitely transmissible disease, but further studies will have to be undertaken before we are in a position of sufficient information to explain the occurrence of the diseases as ordinarily seen.

Similar studies have been made by Clough.¹⁴³ In her series it is

¹⁴² *Journal of Experimental Medicine*, October, 1917, p. 513.

¹⁴³ *Bulletin of Johns Hopkins Hospital*, October, 1917, p. 306.

interesting to note that in a number of children the instance of group I and III was lower, with a correspondingly higher instance of group IV and atypical II, as compared with lobar pneumonia in adults. If the empyemas in children are added to the pneumonias the instance in groups I and II becomes slightly higher than in the pneumonias in grown people.

Previous observations on the type of the organism found in the pneumonias of children have been made by Pisek and Pease,¹⁴⁴ Wollstein and Benson¹⁴⁵ and Mitchell,¹⁴⁶ and these observers found a higher percentage of pneumonias due to group IV in children than in adults. Their observations were made with cultures from sputum, whereas Clough's studies were made of material secured by lung puncture which, perhaps, accounts for the difference. Another epidemiological study is that by Sydenstricker.¹⁴⁷

METHODS FOR THE DETERMINATION OF THE PNEUMOCOCCUS TYPES. Blake¹⁴⁸ has a very interesting article on this subject which should be consulted by anyone wishing to carry on investigations of the pneumococcus. Space will not permit an extended description of these methods which are of chief interest to laboratory workers.

NEUTRALIZATION OF ANTIPNEUMOCOCCUS IMMUNE BODIES. Cole¹⁴⁹ has shown that empyema fluids which result from infection with pneumococci contain large amounts of soluble substances which have the property of neutralizing the pneumococcus antibodies, and also that similar substances are found in the blood of infected rabbits. When immune serum is injected into infected rabbits, the immune substances disappear very quickly, and, on account of being neutralized, are prevented from acting upon the infection. This rapid disappearance of the immune bodies after injection with the serum into human beings with pneumonia has also been noted, and the disappearance is probably associated with the presence of soluble substances in the blood similar to those found in the empyema fluids in the blood of rabbits. In order to be effective, these substances must be neutralized, and, in consequence, the severely affected patients must receive the serum very early and the initial dosage must be very large. Cole has applied the study of the agglutination test in following cases in which the immune serum had been used, and believes it is of value in showing why favorable results have not followed the use of the serum.

THE PRODUCTION OF ANTIPNEUMOCOCCUS SERUM. Space prevents me giving the details of the production of the antipneumococcus serum, but anyone especially interested will find a very interesting account by Cole and Moore¹⁵⁰ in a report from the Rockefeller Institute for Medical Research.

SERUM THERAPY IN LOBAR PNEUMONIA. Practically all cases of lobar pneumonia are due to the pneumococcus. The most important

¹⁴⁴ American Journal of Medical Sciences, 1916, vol. cli, p. 14.

¹⁴⁵ American Journal of Diseases of Children, 1916, vol. xii, p. 284.

¹⁴⁶ Pennsylvania Medical Journal, 1916-17, vol. xx, p. 343.

¹⁴⁷ Bulletin of Johns Hopkins Hospital, October, 1917, p. 312.

¹⁴⁸ Journal of Experimental Medicine, July, 1917, p. 67.

¹⁴⁹ Ibid., vol. xxvi, p. 453.

¹⁵⁰ Ibid., October, 1917, p. 537.

contribution to the understanding of the pneumococcic infections is differentiation of the various strains. Cole and his associates, working in the Rockefeller Institute for Infectious Diseases, has suggested four groups, which are known as I, II, III, and IV. About 75 per cent. of all cases are caused by one of the first three strains. Type IV really does not represent any particular strain, but all of the other strains which do not come under the first three are grouped here for the sake of convenience. The test for separating the various strains consists of inoculating the fresh sputum into the peritoneal cavity of a mouse, and, after the organisms have had time to grow, that is, from six to twelve hours, the peritoneal cavity is washed out and the pneumococci tested for their agglutinating properties, so that in capable hands the diagnosis of the type of infection may be made in from eight to fourteen hours. The frequency of the different types have been given by Cole, Longcope and Richardson, and the following table was prepared by Park:

Number:		Per cent. incidence:	P. H. per cent. mortality:		No.
Cole, Longcope.		Cole, Longcope.	Cole, Longcope.		
I.	78 ¹⁵¹ (13)	33 ¹⁵¹ (23)	25.0 ¹⁵¹	(12.5)	60
II.	75 (11)	32 (21)	29.0	(72.7)	39
III.	22 (7)	9 (14)	45.0	(85.7)	13
IV.	48 (21)	20 (40)	12.5	(23.8)	83
Other bacteria		14	6		

University of Pennsylvania Hospital, Richardson,

	Per cent. incidence.	Per cent. mortality.
I.	31	30
II.	20	25
III.	6	50
IV.	43	12

About 30 per cent. of the cases of pneumonia and about one-third of the total deaths are due to type I. When attempts were made to develop an effective serum the organisms were injected into horses, and it was found that type I produced an effective serum with sufficient immune bodies to be of practical value in the treatment of human beings. Type II developed immune bodies only to about 10 per cent. as compared to type I and much less to type III. In neither types II or III was the response sufficiently great to be of any practical value at the present time. The organisms grouped in type IV react variously, some producing antibodies and some not. The strength of the serum is measured by injecting a definite dose of virulent toxin together with a definite amount of serum, using mice for the observations. The value of the serum depends on the amount of immune bodies present, so that only type I can be used in the actual treatment of human cases; but it seems possible that by using other methods efficient serum may, in the future, be produced for types II and III.

Cole¹⁵² has summed up the experiences in the Rockefeller Institute. He states that in the experiences there about one-third of the cases are due to infection of type I, one-third to type II, 10 to 15 per cent. to

¹⁵¹ Presbyterian Hospital, Longcope.
¹⁵² Journal of American Medical Association, August 18, 1917, p. 505.

type III, and the remainder to type IV. Cases due to types I and II are usually of average severity, the mortality being 25 to 30 per cent., while those due to type III are very severe, one-half or more of the patients dying, whereas group IV cases show a milder form of the disease with a mortality around 10 or 15 per cent. This helps in making a prognosis, and Dochez and Avery have shown that a heavy precipitin reaction in the urine is in favor of a bad outcome. A very large number of colonies per cubic centimeter in the blood plates in cases with the more serious types of infection is also a bad sign. In regard to type I infections, 105 cases have been treated with serum, and 97 have recovered and 8 died. Of the 8 fatal cases, 3 were treated only a few hours before death, 1 died on the sixteenth day of the disease of pulmonary embolism, 1 died on the fifty-fourth day with a general streptococcus infection, following empyema, one was found at autopsy to have tuberculosis, with only a small area of pneumonia. This leaves only 2 in which the treatment was adequately carried out. One died on the sixth day and 3 on the twelfth. During the past winter, of 35 patients treated, only 2 died.

Craig and Nichols, in a series of cases in troops along the Texas border, report a mortality of only 5 per cent. in group I cases.

Cole does not believe in administering the serum until the type of the organism had been determined. Park, on the other hand, is of the opinion that the first dose of antitoxin could very probably be administered early and the treatment discontinued in the cases in which type I infection was not found. Cole is also against the use of any of the other polyvalent serums. The earlier his serum is administered in any infection amenable to such treatment the better the results, and this seems to be undoubtedly true in pneumonia where the serum has a definite antibacterial action. Up to the present time the antipneumococcus serums have not been standardized, but the matter is at present under consideration by the Hygienic Laboratory of the United States Public Health Service. Cole states that an effective serum is one which will be equal in potency to the standard serum, 0.2 c.c. of which protects a 20-gram mouse against 0.1 c.c. of a culture, of which 0.000001 c.c. alone will kill. In testing the various commercial antipneumococcus serums, Cole found that some had very little potency against type I and some no protective power whatever against any type with which he was familiar. The dosage at present has not been fixed, but for a full-grown person from 75 to 100 c.c. is injected intravenously, preferably after diluting it once with freshly prepared sterile salt solution. This dilution is not an essential, providing the serum is injected very slowly. This amount may be repeated every six or eight hours, and in most instances two or three doses are sufficient. The average amount in the cases treated has been 250 c.c. There is a slight elevation of temperature an hour or two after the serum is administered, and this is followed by a marked drop, but very often after eight to twenty-four hours goes up again.

Cole believes that it is very important to watch the patient after the administration of the serum, the temperature being taken every two

hours, and, when the rise begins, the serum is repeated. If there is no change after the first dose, a second may be given within six or eight hours. The object of administering the serum is to bring about a condition in the patient's blood in which the antibodies are concentrated, as they would be during the natural recovery from the disease. This concentration is interfered with by the bacteria circulating in the blood fixing the antibodies and also by the fact that the blood of infected patients contains soluble antigenic substances which also fix the antibodies and render them ineffective. In severe cases these substances may be present in very large amounts, and this explains why so much more serum is needed in both late and severe cases, as these substances must be taken care of before an effective concentration of the serum is reached. The injection of such large quantities of serums may, in sensitive persons, cause severe reactions, and Cole believes that on admission to the hospital a small dose of 0.5 to 1 c.c. of horse serum be injected subcutaneously. This has been done at the Rockefeller Hospital, even when the skin reaction has not shown that the patient is sensitive. During the several hours which elapse before the type of the infecting organisms has been determined the patient will have been desensitized. The skin test is made by injecting into the patient's skin, not under it, a small amount of serum, and if there is a characteristic edema and local erythema within an hour afterward it shows the individual is sensitized to the serum, and if there is no reaction that he is not. The shock of injecting large quantities of serum into a sensitized individual can be avoided by the small initial subcutaneous injection and by exceedingly small injection of the therapeutic dose. The serum is given intravenously, and the first cubic centimeter should take at least fifteen minutes. If this does not produce any reaction the remainder may be injected more rapidly and the subsequent doses without this delay. When the patient is sensitive to the initial dose, very small injections may be made first and repeated, giving more each time. Alexander, at the Peter Bent Brigham Hospital, has been able to thus treat patients who were sensitive to horse serum without any severe anaphylactic shock. The second danger, a serum reaction, is one which is similar to that which is sometimes seen after injections of salvarsan or large doses of vaccine. It may come on during the administration or an hour or more afterward. There may be a high elevation of temperature with an abrupt fall, together with restlessness, tachycardia, flushed face, sweating and, occasionally, vomiting. Cole does not believe that these reactions have anything to do with the beneficial effect, as some have claimed for similar reactions after large doses of vaccine, but has found that a large dose of vaccine is liable to produce such reactions. Such serum should not be used, and if the patient shows any signs during the injection it should be discontinued immediately. Prompt relief may usually be had by injection of 0.5 c.c. of epinephrin solution or 0.01 grain of atropine. Subsequently the patient may show the various symptoms described as serum sickness, that is, elevation of temperature, urticarial eruptions of the skin, enlargement of the lymph nodes, sometimes edema of the skin and pains in the joints.

BILATERAL PNEUMOCOCCAL PAROTITIS. Parotitis due to pneumococcus infection has been described very infrequently. Osler and McCrae's *Modern Medicine* gives 20 cases as having found their way into medical journals, and Moore states that it was found only 6 times in nearly 6000 cases of pneumonia in the Vienna Hospital. Zesas, in 1910, described a case and found 27 others reported as complicating pneumonia.

Barrow¹⁵³ has described an instance of bilateral parotitis occurring in a woman, aged sixty-seven years. She had what appeared to be a deep-seated bronchitis which may have been an actual pneumonia, and some ten days after the onset, when the lungs were beginning to improve, had a chill followed by fever and very marked general symptoms, with pain in the left parotid region. A few days later the gland was markedly swollen and painful, and the opening of the duct was pouting and reddened. A large amount of greenish-yellow mucus could be expressed. A few days later the right became involved in the same manner. Examination of the pus revealed a pneumococcus in pure culture. The convalescence was slow, and after nearly two months the pus was replaced by clear, rather salty, secretion.

Out of 30 cases reported up to date, only 8 were bilateral, and, as a rule, the process goes on to suppuration. In this particular case an interesting point is the fact that the disease ended by crisis some five or six days after the onset, at which time the temperature dropped to normal and below, there was a profuse sweat, and after that there were only toxic symptoms when the mouths of the ducts became blocked.

A New Antirabic Cure. Fermi¹⁵⁴ has devised a serovaccine made from the emulsion of brain substance of the rabbit or dog in the strength of 5 per cent., to which 1 per cent., phenol is added as a preservative. This is mixed with the serum obtained from a horse, using the vaccine as an antigen and then injecting it subcutaneously. The author claims to have perfect results in the prevention of the disease.

Neuritis and Paralysis as a Complication of Antirabic Injections. Geiger¹⁵⁵ has made a short report on this subject, which I reviewed at some length in *PROGRESSIVE MEDICINE* in March, 1917, commenting on the observations of Hasseltine, Fielder, and others. These previous reports include 142 cases, with 24 deaths, to which Geiger adds 8 additional cases, bringing it up to 150, and, in addition to this, he has reported 7 cases of neuritis. The percentage of persons showing involvement of the central nervous system during the antirabic treatment is about 0.9 per cent. No children were affected in Geiger's small series, and it is interesting to note that the paralysis occurred in one individual who took the treatment who had not been bitten. In one instance there was facial paralysis alone, and there were some bulbar symptoms in another. Most of the cases, however, were simply a mild myelitis, with general involvement of the legs and the sphincters. The shortest incubation period of the paralysis was ten days and the longest twenty-eight days. He also had two instances in which optic neuritis had occurred, this being the first time that this complication had been noted in the literature.

¹⁵³ Journal of American Medical Association, June 9, 1917, p. 1680.

¹⁵⁴ Supplemento agli Annali d'Igiene, Anno xxvi.

¹⁵⁵ Journal of American Medical Association, February 17, 1917, p. 513.

Another interesting contribution on this subject is by Carlos Ramos Mejio,¹⁵⁶ of the Pasteur Institute of Buenos Ayres. In 1911 the same author presented 10 cases in his inaugural thesis. Since that time he has observed some additional cases at the institution in question. They have treated 19,800 persons with 24 cases of paralysis, 4 of which resulted fatally. In 7 of these cases the paralysis was limited in extent and lasted a comparatively short time and disappeared more or less completely. One instance was in a child of six years who, one month after the completion of the treatment, fell from a hammock and on the following day had an ascending paraplegia which resulted fatally in two weeks. In the other cases there was also an ascending paralysis developing a day or two after the treatment, and proving fatal in two or three days' time.

Rat-bite Fever. In 1916 I reviewed at some length the subject of rat-bite fever and last year I noted the work of several observers in reference to a spirochete described by Futaki, Takaki, and Taniguchi and Osumi,¹⁵⁷ and called by them *Spirocheta morsus muris*. These same observers have contributed a second article in which they have found the same organism in 5 out of 6 more cases they have studied. The organism was found in the swollen local lesion of the skin and in the enlarged lymph nodes. Inasmuch as the organisms are present in small numbers, they consider it easier to inoculate the material into a mouse and later examining the blood, when the organism will be found present in five to fourteen days, or, at the latest, in four weeks. The disease may be transmitted to mice, house rats, white rats and monkeys. Guinea-pigs are also susceptible. They found that the spirochete could be detected in about 3 per cent. of house rats and believe that the disease known as rat-bite fever in Japan is due to the spirochete which they have described, but they also allow that other organisms might be responsible for other forms of disease caused by rat bites. They call attention to the fact that the spirochete described in the blood of rats or mice did not fully agree with the description of the one which they have studied.

Ishiwara, Ohtawara and Tamura¹⁵⁸ have also made a study of the disease and described an organism, also a spirochete, which differs in form from that described by the observers just quoted. The spirochete of both observers is easily killed by salvarsan.

This whole subject of rat-bite fever needs further study, but it seems very probable that the various organisms described of the same general nature will be found to be essentially the same, although perhaps differing in slight particulars.

Kaneko and Okuda¹⁵⁹ call attention to the fact that just as in Weil's disease so in rat-bite fever the distribution of the organisms varies with different stages of the illness. At the beginning of the disease the organisms circulate in the blood, while in the convalescent stage, when immune bodies are completely developed, they can be demonstrated only in the kidney. They believe that the long and short types of spirochete belong

¹⁵⁶ La Semana Medica, January 4, 1917, p. 10.

¹⁵⁷ Journal of Experimental Medicine, 1917, vol. xxv, p. 333.

¹⁵⁸ Ibid., p. 45.

¹⁵⁹ Ibid., September, 1917, p. 363.

to the same species and that the two different types grade into each other, morphologically speaking. They think that the short spirocheta are the earlier forms of the organism, and that as the long ones occur almost exclusively in human tissues they may be regarded as old or degenerated forms.

Ido, Ito, Wani and Okuda¹⁶⁰ made a study of the circulating immunity principally, and found that persons who have recovered from the disease have an immune body in their blood which will destroy the spirochete, which seems to confirm the opinions of Futaki, who seems to have established the identity of the two types of spirochete.

In connection with rat-bite fever it is interesting to note that Hektoen has described the various lesions of bronchopneumonia in white rats, a disease which seems to be of frequent occurrence. The same disease has been studied in gray rats, and Tunnicliff¹⁶¹ has studied a streptothrix found in the lesions which is very similar to the *Streptothrix muris-ratti* described by Schottmüller and Blake in man. The acute lesions in the lung have been reproduced by inoculating the animal intraperitoneally with cultures of the organism.

Relapsing Fever. CULTIVATION OF THE SPIROCHETE OBERMEIERI. Plotz¹⁶² has made a report upon the cultivation of this organism, which, so far as I know, has not been grown up to the present time. Plotz calls attention to the fact that, so far as he has been able to discover, no spirochete of any species has been cultivated directly from the blood of human beings. His observations were made in Serbia in the winter of 1915, and cultures were made in 5 cases, all of which were successful. Clinically, the disease was the European relapsing fever. His article is accompanied with 3 very good illustrations of the organism in the blood and in cultures.

The method of cultivation employed was the same as that used by Noguchi, which I described in detail in *PROGRESSIVE MEDICINE* for March, 1914, with reference to the cultivation of the organism causing poliomyelitis. The organisms were transferred, and in two instances were transplanted for five generations. In the young cultures the spirochete are shorter and thinner, but in the older ones they become thicker and longer. In the young cultures there are spirochetal nodes which appear in practically every organism. These are small thickenings which occur in the body, and from one to four may be seen in the same organism. As the cultures become older, these nodes become less numerous. Plotz believes that these nodes represent the points where longitudinal division occurs.

Incidence of Intestinal Parasites in Buenos Ayres. Parodi and Widakowich¹⁶³ have made some extensive observations on this subject in the Ramos Mejia Hospital, and they believe that the percentage of individuals infected with intestinal parasites is very large in that part of the Argentine. They found that 54 per cent. of the adults, and over 74 per

¹⁶⁰ *Journal of Experimental Medicine*, September, 1917, p. 377.

¹⁶¹ *Journal of Infectious Diseases*, 1917, vol. xix, p. 767.

¹⁶² *Journal of Experimental Medicine*, July, 1917, p. 37.

¹⁶³ *La Semana Medica*, September, 1917, p. 303.

cent. of the children, were infected. The parasites most frequently observed were the *Entameba coli* and *Lamblia intestinalis*. Among the protozoa they found the *Hymenolepis*, and the trichiurus among the worms. Double infections were also extremely common, over 14 per cent. of adults showing more than one species and over 28 per cent. of the children. Most frequent associations were *Entameba coli* and *Lamblia*; *Entameba coli* and *Trichocephalus*; *Lamblia* and *Trichocephalus*; *Entameba coli*, flagelados and *Trichocephalus*; and *Entameba coli*, *Trichocephalus*, and *Hymenolepis*. The larger part of the individuals were laborers without any appearance of disease. The authors believe that an examination of the stools with reference to the intestinal parasites is a very important part of the examination of a patient, and one which is all too frequently neglected.

Blood Cultures in Rheumatoid Arthritis. Moon and Edwards¹⁶⁴ have made a study of this subject which has been the object of investigation by a number of observers. Several years ago, Rosenow isolated a non-hemolytic streptococcus in 5 of 9 cases of rheumatic fever during the height of the fever in an attack, and in cases of proliferating osteo-arthritis and in arthritis deformans. Taking the lymph nodes from the areas draining the infected joints in 54 cases, he isolated a modified *Streptococcus viridans* from 32 cases, staphylococcus in 5 cases, *Bacillus mucosus* in 3 cases, *Bacillus welchii* in 14 cases, and diphtheroid bacillus in 5 cases. The *Micrococcus catarrhalis* and gonococcus were isolated once each. Moon and Edwards, in a total of 40 cases of acute arthritis, found a non-hemolytic streptococcus in 13, *Bacillus mucosus* in 2, diphtheroid bacilli in 2, hemolytic streptococci once, and staphylococcus once, and 21 were negative; while of 83 cases of chronic arthritis, non-hemolytic streptococci was found in 18, *Bacillus mucosus* was found 3 times, diphtheroid bacilli, 3 times, and unidentified organisms once, and cultures were negative in 58. Autogenous vaccines, they state, combined with other measures, have been followed by marked improvement.

I have had under observation for several years a very remarkable instance of arthritis with involvement of almost all of the joints, the child being bed-ridden for nearly a year, and during this time running a temperature almost every day of 105° with normal periods in between. A streptococcus was isolated from the blood and a vaccine used, with the result that the child is practically well, the only changes being slight stiffness of the spine, with slight, but not serious, deformities of the wrists, small joints of the hands, and the knees and feet. The child has been practically perfectly well for over twelve months.

Streptococcus and Septic Sore Throat. I have commented a number of times concerning the association of the streptococcus and septic sore throat. Anyone interested in this subject will find the Boylston medical prize by Smillie¹⁶⁵ of inestimable value. His studies were made during the milk-borne epidemic in Dorchester in 1915, and on an epidemic of tonsillitis at a boarding school and under a number of other conditions.

The organism isolated from the throats of patients in the Dorchester

¹⁶⁴ Journal of Infectious Diseases, August, 1917, p. 154.

¹⁶⁵ Ibid., 1917, vol. xx, p. 45.

epidemic was found to be identical with a streptococcus isolated from the suspected milk, and a streptococcus from the boarding school epidemic, which was also milk-borne, was found to be identical with a streptococcus isolated from the udder of one of the cows from the school dairy. Both of these organisms were found to be in every way identical with the streptococcus described by Smith and Brown in their studies of the milk epidemics of Massachusetts in 1914 and 1915, which was referred to as the beta-hemolytic streptococcus, is of a human strain with a group of definite characteristics. This organism is rarely found in normal throats, in Smillie's experience in 1 per cent. in which cultures were made. After attacks of tonsillitis, however, this organism may be found for three months or more after the acute symptoms of the disease have subsided. In sporadic tonsillitis, out of 20 cases, 5 were found in which this type of streptococcus was present. Clinically, the disease may be either severe or of a moderate type. In the throats of acute cases of scarlet fever this organism may be found and may remain for months in the purulent discharges when there is involvement of the ear or other complications. These observations would go to show that septic sore throat is not necessarily due to infection through milk, but that it may exist in either an epidemic or sporadic form, and it also shows how it is possible for epidemics of septic sore throat to arise from organisms from scarlet-fever patients, the disease produced being not scarlet fever, but the local throat infection. Taken all in all, this piece of work is one of the best which has come to my notice for some time.

Smallpox. VACCINE TECHNIC AND RESULTS. Force and Stevens¹⁶⁶ have made a series of observations, which are very interesting, relating to the nature of the vaccination lesion through several different factors. They found that the severity of local reactions was apparently uninfluenced by the method of preparation of the vaccine or the bacterial count at the time of release. They also determined that the course of the primary vaccine is apparently uninfluenced by the application of antiseptics.

Three methods of preventing sore arm have been suggested; one by Schamberg and Kolmer, who paint the vesicles at the end of forty-eight hours with a preparation of 5 per cent. alcoholic solution of picric acid. Dyer clips the top with sterile scissors and cauterizes the base with a 6 per cent. solution of silver nitrate, and others have suggested painting the vesicle as soon as it appears with tincture of iodine. Unna uses a mixture of 8 parts of zinc oxide ointment and 1 part each of calcium carbonate and sulphur lotum.

According to Force and Stevens, none of these methods seem to have any advantage over the method which they advise. They found that the thing which did influence the after-results was the nature of the primary scarification, and that cross scarifications tended to produce larger, more delicate vesicles, with consequent secondary infection and sloughing, whereas the use of three small scarifications which give rise to small vesicles and which are not easily broken and which do not tend to be infected with other organisms or to slough, are much to be preferred.

¹⁶⁶ Journal of American Medical Association, April 28, 1917, p. 1247.

SMALLPOX VACCINE AND SUBSEQUENT INFECTIONS. Kinloch¹⁶⁷ has made a comparative study of various infectious diseases of children, with reference to their occurrence in children who had been vaccinated and those who were unvaccinated, and also with reference to the sequelæ and complications. The observations covered scarlet fever, diphtheria, measles, whooping-cough, erysipelas, bronchopneumonia and typhoid fever. Space prevents quoting his figures, but there is no evidence that vaccinia has any prejudicial effect on the child's well-being as judged to its response to subsequent infection.

Tetanus in Court Plaster. Owing to the statements made in the public press about contaminations of court plaster with tetanus, McCoy, Luke and Korbit¹⁶⁸ made a careful study of court plaster as it is ordinarily bought, and out of 13 specimens purchased in Washington, 2 showed the presence of tetanus organisms, but there is no evidence whatever that any of these specimens were intentionally contaminated. There was no clear evidence that the court plaster as it left the manufacturer carried the organism, but their observations show that it may be contaminated before it reaches the user.

The Effect of Soap on the Treponema Pallidum. For a number of years I have been convinced that the free use of soap and plenty of running hot water was all that was necessary in cleansing the hands after examining patients with infectious diseases. It therefore has been of particular interest to note the observations of Reasoner.¹⁶⁹ He ascertained that a solution of soap, made out of ivory soap or some of the shaving creams, all of which seem to be equally effective, would immediately render the spirochete non-motile. Equal parts of a richly infected testicular juice and soap solution were mixed thoroughly, and then, as quickly as possible, placed on a dark field for from fifteen to thirty seconds, but in no instance could a motile spirochete be observed.

From the results of these observations one is led to doubt the infections supposed to take place in the barber shop, unless the transmission was made by a towel wet only in water and so allowing transmission from one patron, or from the barber himself, to the individual who was shaved. After shaving, there are minute abrasions on the face which lend themselves to infections, either from the towel, as mentioned above, or other more probable sources of infection.

The Treatment of Trichinosis with Thymol. Booth, Goehring and Kahn¹⁷⁰ have suggested this method of dealing with cases of trichinosis. Two periods must be considered, one when the parasite is in the intestine, the other when it is in the muscles and tissues of the body. The usual method of administering thymol for intestinal parasites may be employed, and Stiles gives it as administered with magnesium or sodium sulphate with plenty of water the evening before the thymol is to be given. Early the next morning, no breakfast is given, and the patient, if an adult, is given 2 gm. of powdered thymol in capsules and another 2 gm. two

¹⁶⁷ Lancet, June 30, 1917, p. 993.

¹⁶⁸ Public Health Reports, September 7, 1917, p. 1450.

¹⁶⁹ Journal of American Medical Association, March 31, 1917, p. 973.

¹⁷⁰ Ibid., December 30, 1916, p. 2000.

hours later, after which another dose of salts is administered. The following dosage has been suggested:

Under 5 years	0.5 gm.
Between 5 and 10 years	1.0 gm.
Between 10 and 15 years	2.0 gm.
Between 15 and 20 years	3.0 gm.
Between 20 and 60 years	4.0 gm.
Above 60 years	2.0 to 3.0 gm.

During the administration of thymol, oils, fatty foods and alcohol should be very strictly forbidden, and the drug should not be used, or only with extreme caution, in very old persons, during pregnancy, advanced cardiac disease, or when there is anasarca or marked diarrhea or dysentery.

Thymol given by the mouth has no effect upon the organisms in the muscles, inasmuch as it is neutralized in the liver. The authors quoted suggest the following method for the administration of thymol in the cases in which the parasite is in the muscles or other tissues: 50 grains of thymol are dissolved with 50 c.c. of sterile olive oil. This solution is then sterilized and 2 to 3 c.c. injected either subcutaneously or intramuscularly for seven days. After several days' rest, the injections are repeated.

The authors report one instance in which this method was used with success. The patient had a marked eosinophilia, over 20 per cent., and encapsulated parasites were found in the muscles. Following the injections, the temperature rapidly subsided and the pain in the muscles and the swelling of the conjunctivæ disappeared, and the patient was dismissed from the hospital as cured. It was noticed, following the administration of thymol, that the percentage of eosinophilia was markedly increased to 30, 45, and as high as 55 per cent. This, they believed was due to the destruction of the parasite and the absorption of the protein of the parasite into the blood. The only discomfort suffered by the patient was a rash on the hands which disappeared after the thymol was discontinued.

Trench Fever. There have been quite a number of contributions on the subject of this disease which has been noted since 1915. An account of the disease has been given by Costello.¹⁷¹ The patients entered the field ambulance with fever which ran a very unusual, but constant, course. In the early days the diagnosis was usually made of influenza, of myalgia, sometimes of rheumatism, septicemia, or an auto-intoxication. Finally, the term trench fever was suggested. The disease, as observed so far, has occurred in men, for the most part adolescent soldiers, but not always. The disease has occurred in France and Belgium, and, as noted below, infection has occurred in England from cases sent home. Costello doubts if the disease has occurred in the East. It is more apt to occur in spring, summer and autumn, and is decidedly less frequent in winter. More of the cases occur in the trenches than in those who were behind the line. No organism has been isolated as yet, but it has been thought

¹⁷¹ Practitioner, 1917, vol. xeviii, p. 456.

that lice play a very important part in its causation. Anxiety, strain, overwork and worry, wet and cold, and sleeplessness are all given as things predisposing to the disease.

Fever generally shows itself on the first day of the disease and varies between 99° and 102°, lasts from three to seven days and then becomes normal. After a period of from three to eight days there is a recurrence followed by another normal period and then a third febrile state and a normal period, and, occasionally, a fourth attack, sometimes there may be only two. The temperature generally subsides by lysis, but a crisis may occur. There are pains in the head of a neuralgic type and pains in the legs, which is almost diagnostic. The pains start in the back of the knee, and course around the front of the knee, but the knee-cap area is usually not painful. The pain runs along the shins to the ankle-joint, and, while the pain is very intense, is limited to its localization. When the fever is low, the pain is not so great, and during the normal period the pain is usually absent. Occasionally it is referred in the lumbar region, or to the feet. There is also distinct tenderness. The area of splenic dulness is increased in some cases, but the spleen is usually not palpable, although there may be tenderness in the splenic region. Constipation is common, but there were no other suggestive respiratory, cardiac or digestive symptoms, though these may be met with from other causes. There is also a dirty tongue and weakness, with the usual febrile symptoms during the pyrexial recurrences. Night-sweats are frequent, but are referred to the drugs used in treatment.

Various studies directed toward the bacteriology of the disease have resulted negatively. The treatment is unsatisfactory, no results were obtained from quinine, potassium iodide, arsenic, or sodium salicylate.

McCrea and Dickson¹⁷² have suggested that the disease may be due to a spirochete, and in the vast majority of cases the patients give a positive Wassermann reaction. Riemer,¹⁷³ whose article I have not been able to consult, has succeeded in growing the spirochete in anaërobic blood cultures in some cases.

Wenyon¹⁷⁴ has described a small hemogregarina in the lizard. An organism very similar to this has been described as occurring in the blood, liver, spleen and lung punctures of trench fever. Among the contributions along this line is one by Dimond.¹⁷⁵ The technic of demonstrating the organism consisted, first, of the usual absolute cleanliness, and cleanliness of all the apparatus, and of the required purity of the distilled water. Two cubic centimeters of venous blood is syringed into a sterile solution of 1.8 per cent. sodium citrate and to this are added 2, 3, or 4 c.c. of a 0.5 per cent. solution of saponin previously filtered and sterilized in order to cause complete hemolysis of the red cells and more or less complete destruction of the leukocytes. This fluid is then centrifugalized for one and a half to two hours, the supernatant clear fluid poured off and the deposits poured on glass slides. Some of the material

¹⁷² *Lancet*, May 26, 1917, p. 796.

¹⁷³ *München. med. Wehnschr.*, 1917, No. 3.

¹⁷⁴ Third Report, Wellcome Research Laboratories at the Gordon Memorial College, Khartoum, p. 153.

¹⁷⁵ *Lancet*, September 8, 1917, p. 382.

was also mounted unstained by placing a drop on the slide within a thin circle of sterile paroline and covered with a slip; from this the organism could be observed for considerable periods of time, as the thin layer of paroline surrounding the drop of the deposit prevents evaporation. The organism was found to be most numerous just preceding the fever, and, when blood was taken at this time, 3 or 4 c.c. of the suspension, of 2 c.c. of the blood in the sodium citrate solution, were added to 12 or 15 c.c. of sterile distilled water. The water causes hemolysis of the red cells and swelling up of the leukocytes.

The organisms are not demonstrated in the cerebrospinal fluid. Two common types of the organisms are found in the venous blood a day or two before the onset of the fever. First, macromerozoites, 7 to 13 microns long, and generally free in the plasma, and micromerozoites, usually encysted in the red corpuseles, usually varying from 3 to 4 microns in length. In addition to these there are slender, free, or encysted sausage-shaped forms, 4 to 6 microns long by 3 to 4 wide. These may be arranged so as to form a rosette appearance. The organism may be stained by Giemsa's method. Dimond found that the quickest way to make the diagnosis was by obtaining specimens from the splenic puncture. He also suggests the probability that the pediculus corporis may be responsible for transferring the disease, or, what he thinks more probable, that a louse allied to the *Hematopinus stephensi*, described by Newstead and Christophers as parasitic on the Indian field rat. The presence of large numbers of rats in the trenches is another reason for seriously considering this suggestion.

MacGregor¹⁷⁶ has described a case of trench fever occurring in an army orderly who had never been out of England. The disease was evidently contracted from being in attendance on patients who had contracted it in France and been invalided home.

Trench Foot. Among the various diseases that have been described in the war is an affection called trench foot. Sherwood-Dunn¹⁷⁷ has given a short account of it, and other articles are by Raymond and Parisot,¹⁷⁸ Collet¹⁷⁹ and Rathery and Bauzil.¹⁸⁰ In most instances the disease is contracted in trench life; at first it was thought to be due to cold, but it was soon discovered that the disease also occurred in summer time. The physical signs are typical. There is swelling of the ball of the great and second toe with some edema; the skin is shiny, and there is sometimes the formation of vesicles. The edema may extend to the other toes from the bottom of the foot, and the color changes from rose to red or violet, and, in the worst cases, there is hemorrhage under the skin and gangrene. The vesicles may crust and fall off, leaving an ulcerating base; there is very marked pain, and, in the more severe cases, fever. It is most commonly seen in men between the ages of twenty and thirty years.

Raymond and Parisot found an organism something like the fungus

¹⁷⁶ British Medical Journal, February 17, 1917, p. 221.

¹⁷⁷ New York Medical Record, June 30, 1917, p. 1143.

¹⁷⁸ Presse médicale, October 19, 1916. Paris médicale, March 24, 1917.

¹⁷⁹ Ibid., March 17, 1917.

¹⁸⁰ Ibid., March 31, 1917.

of Madura foot disease. This is principally isolated from the vesicles, and causes the same lesion in the skin of rabbits and guinea-pigs. Tetanus is a complication, as are also abscesses, neuritis and lymphangitis. The disease can apparently be prevented by the use of camphorated oil. Raymond and Parisot suggest the following method of treatment in the simple, edematous form: The foot should be thoroughly washed in warm water with the following: Green soap, 1000; camphor, 25; borate of soda, 100. Care should be taken not to break the skin or open any vesicles. The foot is then carefully dried and covered with a layer of absorbent cotton soaked in a solution of camphor, 1.1; borate of soda, 15; in boiled water, 1000. This is covered with oiled silk, or some similar material, and kept in place by adhesive plaster. The dressings are changed daily for about six days; following this, camphorated oil may be applied without rubbing. When vesicles are present, if they are smaller than a dime, they are best let alone, but if they are very extensive and the surfaces hemorrhagic, it is suggested that the surfaces be denuded and the gelatinous base carefully removed by aid of a sterile tampon, then the denuded surfaces covered with compresses soaked with camphor, 30; in ether, 1000. The foot is then covered with the dressings mentioned above and changed daily. When crusts are present, they should be removed, using no force and causing no bleeding. It may take days before the surfaces can be properly cleansed. If there is a tendency to recur, Reclus suggests the following ointment: Vaseline, 200; boric acid, 3; iodoform, 1; antipyrine, 5; salol, 3; carbolic acid (crystals), 1; bichloride of mercury, 0.1. When there is extensive invasion, it may be necessary to make openings and allow the pus to escape and treated along various antiseptic lines, or oxygen may be used, as suggested below. When necrosis has been arrested and there are granulations, an impermeable covering, suggested by Rathery and Bauzil, is advised. This consists of sodium naphtholate, 2; essence of thyme, 3; essence of origanum, 3; essence of geranium, 3; vaseline, 1000; paraffin (45° to 50°), 5000. This is melted and thoroughly mixed by aid of heat and put up in small jars holding 125 grams each, sterilized for twenty minutes at 120° C. When a fresh dressing is applied, the wax is melted by putting the jar in a hot-water bath and covering the affected part with a single layer of sterile gauze and then painting thoroughly with the melted wax. A second and third layer is applied in the same way and then covered with cotton and bandage. This is easily removed, and gives splendid results.

THE TREATMENT OF TRENCH FOOT BY SUBCUTANEOUS INJECTION OF OXYGEN. Among the various suggestions that have been made for the treatment of this infection is one by Oswald Smith.¹⁸¹ He describes the disease occurring in four different stages:

1. The neuritic, in which there is acute pain which prevents the patient from walking or sleeping, but at this time there is no swelling or discoloration.

2. The edematous stage, in which the acute pain is still present, but no discoloration.

¹⁸¹ British Medical Journal, April 21, 1917, p. 511.

3. The edematous stage, with blisters and varying discolorations of the skin short of gangrene.

4. The gangrenous, in which there is edema and blisters, reddening of the skin and partial or circumscribed gangrene.

In all cases of this affection an antitetanic serum should be given, whether the skin is broken or not. Smith suggests injections of oxygen, the needle being passed into the subcutaneous tissue at the point between the heel and the external malleolus. The needle is then withdrawn and inserted midway between the internal malleolus and the heel. In cases in which the toes are black and cold, the needle is also inserted midway at the base of the toes and more given. When there is almost gangrene of the deeper parts, injection into the deeper tissues is advisable.

The treatment is based on the idea that the disease is somewhat akin to Raynaud's disease. The edema causes a stasis in the veins of the foot and the oxygen helps to keep the blood oxygenated and the tissues alive until the serum can be drained away, and it also serves to relieve the edema by draining the serum out of the puncture holes. Most of the cases treated by this method have given very satisfactory results.

Trench Shin. Among the other diseases which the present war has brought out is a form of infectious fibrositis with marked pain and tenderness on pressure over the tibiæ and over the anterior tibials. Chambers¹⁸² has given a short account of this disease which seems to be due to the constriction of the legs by puttees, followed by infection, which is aided by exposure to cold and wet. In the early stages there is headache, fever, and leukocytosis. In addition to the fever, headache and tenderness, there may also be neuritis in the arms, and pain in the ligaments and bony parts about the joints. The pain is worse at night, and the disease generally runs the course of two or three months.

McNee and Renshaw¹⁸³ injected 20 c.c. of blood from a patient, twenty days after his last relapse, intravenously in 2 cases that were just beginning to relapse, but this procedure did not influence the course of the disease. The Japanese, in the Manchuria winter campaign, used inunctions of animal fat or oil for the prevention of this condition and massage has also been suggested, but the treatment of the actual condition itself is not very satisfactory.

Trypanosomiasis Americana. THE CRUZ AND CHAGAS DISEASE. In 1910 Chagas described an organism which he named the *Trypanosoma cruzi*. This organism was first found in the large, biting bug known as the *barbeiro* which is found in the hovels of the poor working class, comes out at night and bites the human being, chiefly the exposed parts of the body. The popular name for the disease in Brazil is the *molestia do barbeiro*. The disease has been described a great many times under various names, as parasitic thyroiditis, by Pereira; coreotripanosis, by Lutz; and has also been known by the name of *molestia de Chagas*, or *molestia de Cruz e Chagas*.

The result of this infection, which is seen most frequently in children, is an extreme anemia accompanied with edema, enlargement of the

¹⁸² Lancet, May 19, 1917, p. 752.

¹⁸³ British Medical Journal, 1916, vol. i, p. 225.

thyroid, spleen and lymph nodes, with marked functional disturbances, particularly relating to the nervous system, and in many instances a mental deterioration resulting in actual idiocy.

Two extensive studies have recently been published by Chagas,¹⁸⁴ who is, at the present time, the chief of the Instituto Oswaldo Cruz. This institution, which seems to be little known in this part of the world, was founded a few years ago by Oswaldo Cruz, who, by the way, died last February. He was a pioneer in the study of the parasitic diseases in Brazil, and deserves to be ranked among those who have contributed largely to the advance in the study of infectious diseases. This institution publishes very valuable and exceedingly handsome *memorias*, which appear at irregular intervals, but always at least one number a year. They are printed in Portuguese, and, until very recently, with a parallel translation, in former days in German, more recently in French, and occasionally in English, and the subject matter is practically limited to the infectious diseases and particularly to those due to tripanosomes and other allied organisms.

The first study deals with the pathogenic processes set up by the American tripanosome, and particular attention is paid to the forms in which there is myxedema. He notes particularly that, in the acute forms, very frequently profound alterations in the myocardium takes place, which result in symptoms relating to the heart and circulation, and in a considerable number of cases sudden death results from involvement of the heart. He also calls attention to the fact that the mental degeneration is very largely due, if not entirely so, to the localization of the parasite in the central nervous system and the consequent changes resulting in it; he calls attention also to the fact that the resulting idiocy is therefore of an organic nature, and should be distinguished from that due to hypothyroidism, or an entire lack of thyroid secretion, which have been described by Bourneville as *idiotia myxedematosa*, and what we regard at the present day as very marked cases of cretinism.

The second article deals with the acute form of infection and contains a painstaking study of the symptoms and changes which take place in the various organs, together with the protocols of 29 autopsies. As usual in this publication, the article is illustrated with beautiful figures.

Autotherapy in Tuberculous Meningitis. Autotherapy has been tried in a great many different conditions. In 1890 Gilbert made some observations on the use of the pleuritic effusion which has since been studied in other diseases. Tilli¹⁸⁵ has reported 3 cases of tuberculous meningitis in which the diagnosis was based on the clinical picture, the presence of a positive skin reaction, and, in 2 of the cases, the diagnosis was confirmed by microscopic examination, and, in 1, biologically. These cases were treated, either every day or every other day, with increasing quantities of cerebrospinal fluid, from 1, 2 to 3 c.c. being injected subcutaneously. The frequent withdrawing of the cerebrospinal fluid is of considerable value. In the first case there

¹⁸⁴ *Memorias do Instituto Oswaldo Cruz*, 1916, vol. viii, pp. 4 and 37.

¹⁸⁵ *Il Policlinico Sezione Pratica*, November 19, 1916, p. 1357.

was complete remission of the disease for ten months, when the patient finally succumbed, the second has been cured for three years at the time of the report, but the patient was suffering with blindness and hydrocephalus. In the third case the patient was entirely well at the end of two years, in perfect health without any bad results whatever.

In a disease so uniformly fatal as tuberculous meningitis, anything which promises a cure is worthy of consideration. There is, of course, some question as to whether the cases of tuberculous meningitis died or not. In the literature there are a few scattered cases reported in detail in which the diagnosis was beyond question. I have seen one instance in a young girl in whom there was undoubted tuberculous meningitis who recovered, only to die four months later with a general tuberculosis after having had extensive pulmonary lesions dating from the original infection.

As regards recovery in tuberculous meningitis regardless of treatment, Concetti, in 65 cases, reports 1 as improved, whatever that may mean. Martin,¹⁸⁶ in seven hospitals in London, between 1897 and 1909, in 797 cases of tuberculous meningitis, reports 16 as cured. In the Vienna hospitals during the same period, with 1369 cases, there were 6 reported as cured. Single instances have been reported by Sicard, Tedeschi, Dujardin-Beaumetz, Hutinel and Tixier, and numerous other observers.

Typhoid Fever. THE USE OF MIXED TYPHOID VACCINES. I have commented a number of times on the advisability of using mixed vaccines. Castellani,¹⁸⁷ after large experience acquired in the Serbian campaign and more recently in the Adriatic and Balkan States, renews his advice on the use of vaccines containing three or four organisms. The typhoid, paratyphoid A, and paratyphoid B, or, if necessary, a tetra vaccine including the above with the addition of the cholera organism. The objections that have been urged against mixed vaccines have been that a triple confers only one-third of the immunity, and a tetra vaccine only one-fourth. Castellani has demonstrated, from observations on animals and also on man, that when triple or tetra vaccines are used, immunity is induced for all that are present, and that the quantities of immune bodies and agglutinins elaborated by each species, both in animals and in man, is not appreciably less to that produced in controls inoculated with only one species of bacteria. Sometimes he observed a paradoxical phenomenon, in that the agglutinins for all the species would sometimes be greater than that produced in a control where only one species was used. It has been urged that paratyphoids are relatively rare, but from his experience when very careful diagnosis is made, this does not seem to be strictly true. Another objection has been that it is supposed a much greater reaction is caused by mixed vaccines, but Castellani believes that this is also not true, particularly if vaccines that have been prepared with phenol and salt solution are used. The fact that the various armies of Europe have adopted the triple vaccines is a very good proof that they are regarded

¹⁸⁶ Brain, 1909.

¹⁸⁷ Il Policlinico Sezione Pratica, November 19, 1916, p. 1361.

of greater value than the old-fashioned, simple typhoid vaccine. In the Balkans the mixed infections of the typhoids are not uncommon, and very anomalous paratyphoid-like germs have been described by Castellani, Aertryke, Clunet, Galeotti, and others, under various names which need not be gone into at this time.

These mixed vaccines have been given a pretty extensive trial in the Japanese Navy, and in the work done under the American Red Cross in Europe, and in other places. It is therefore very interesting to review an article of Craig's¹⁸⁸ dealing with the results of observations on the triple typhoid vaccine, that is, one composed of 1,000,000,000 typhoid bacilli, 750,000,000 paratyphoid A bacilli, and 750,000,000 paratyphoid B bacilli per cubic centimeter. The first dose is 0.5 c.c., the second and third each 1 c.c. Inoculations were made subcutaneously, and at intervals of seven days. This vaccine has apparently simply proved to produce immunization against typhoid and paratyphoid fevers, and the local and general reactions do not differ essentially from those occurring after inoculations of the simple typhoid vaccine. It is therefore highly desirable in immunizing individuals for typhoid that the triple vaccine be used in place of the older simple vaccine.

Fifty men in the army were selected for observation and none of these men had been previously inoculated with typhoid or paratyphoid vaccine, none had suffered with typhoid fever and all were in good health at the time of the inoculations. Agglutination tests were made on 25 of the 50 men, the first before the first inoculation, the second before the second inoculation and the third before the third inoculation, and the fourth and fifth at intervals of seven days following the third inoculation. The agglutinin titer of the serum is a good index of what is occurring as regards the formation of antibodies, and only this method was used to determine the effect of the injections.

A study of the results showed conclusively that the combination with the paratyphoid bacilli does not interfere in the least with the production of agglutinins with the typhoid bacillus, and that the agglutinins for each of the three organisms are produced in a satisfactory way when all three are injected at one time.

The temperature reactions were rather common, but while there was a slight rise, as a general thing, it did not go above 100° F., and in only a few did it go to 101° F. even after the second injection, when the greatest rise in temperature occurs after the injection of typhoid vaccine. In almost every instance the rise in temperature was transient and disappeared after the end of twenty-four hours. About one-half of those injected had some headache after the second dose, but in only a few was it at all severe. In a large number of men there was slight general malaise after the second injection, and in about one-fifth of the cases it was sufficient to keep them in bed for a couple of hours on the day following the inoculation. The local reactions were essentially the same as those noted after the ordinary typhoid vaccine.

¹⁸⁸ Journal American Medical Association, September 22, 1917, p. 1000.

CUTANEOUS TYPHOIDIN TESTS. About three years ago, Gay and Force introduced a cutaneous typhoidin test with the idea of determining the degree of immunity by cutaneous reaction, and this has been studied by various individuals since and the suggestion made that the tests should be read by measuring the diameter of the areolæ resulting and reporting the result as the quotient, the diameter of the test areolæ divided by that of the control. Kilgore¹⁸⁹ has contributed a second article dealing with the subject, the details of which need not detain us, but he has come to the conclusion, because of the unreliability of the typhoidin test in its present state of development, that typhoid immunity cannot be determined by this test, and he gives as the reasons for this unreliability the unavoidable variations in the application of the test; the indefiniteness of the readings; and, most important of all, the relatively large amount of non-specific reaction which is produced by typhoidin. He also suggests that varying degrees of inaccuracy exist for other cutaneous tests and that they should be investigated with this in view. He also found that the dried typhoidin is little affected by age.

It is particularly important not to take into account the appearance of the reaction at the end of twenty-four hours, but to make the reading at the end of forty-eight hours.

Force and Stevens¹⁹⁰ have contributed another article on the subject of the typhoidin reaction and they found that the stable preparation could be rapidly prepared by precipitating a concentrated broth culture of *B. typhosus* with 95 per cent. alcohol and subsequent dehydration with absolute alcohol and absolute ether. They place considerable importance on the test, and the students at the University of California were advised to report for the typhoidin two years after vaccination, and recently those vaccinated or revaccinated have been advised to return in three weeks. All persons showing a negative reaction they advise to be revaccinated, believing that by this method one gets a safer margin of protection, inasmuch as the routine administration of typhoid vaccine is, in many cases, not sufficient to produce sensitization to typhoid protein. Their conclusions as to the value of the test are different from those of Kilgore.

TYPHOID IN THE LARGE CITIES OF THE UNITED STATES IN 1916. The American Medical Association has a special article,¹⁹¹ being the fifth of a series on this subject. Boston and New York have both achieved a very enviable position, having a rate of 3.5 and 3.8 per cent. per 100,000 respectively. This low rate is the reward for a persistent campaign to control the disease. A purer water supply, an effort to have a purer milk supply, and the following up of carriers, shows what an able-bodied health department may accomplish. Chicago and Cleveland come next, while Philadelphia and Pittsburgh follow close after and then St. Louis. Detroit, of the larger cities, shows very little improvement, while Baltimore has the highest rate of the cities with a population of over 500,000. A very great lowering in Baltimore,

¹⁸⁹ Archives of Internal Medicine, 1917, vol. xix, p. 263.

¹⁹⁰ Ibid., p. 440.

¹⁹¹ Journal of American Medical Association, March 17, 1917, p. 845.

however, during the past ten years makes it extremely hopeful that this city will soon go into the low class. The rate in the past ten years has been nearly cut in half.

In the smaller cities of from 300,000 to 500,000 population, Seattle leads, with Los Angeles, San Francisco, and Cincinnati close seconds, with Newark close behind, while New Orleans has a rate of 23.4 per 100,000.

In 1916, 33 States had a lower typhoid rate than in 1915 and 26 a higher. Thirty-five cities had a typhoid rate under 10, as compared with 32 in 1915. Sixteen cities had a death-rate under 5 in 1916, while only 5 were under that rate in 1915, 4 in 1914, and 1 in 1913. In 1916, 4 reached the very low rate of 3 or less. The best rate of any city was Cambridge, Massachusetts, with a rate of 0.9.

These reports of the American Medical Association deserve to have the most widespread publicity and the rivalry between cities as to their typhoid death-rate should be one of the best methods in stimulating inhabitants and local government to get rid of what certainly is an avoidable evil. From the stand-points of dollars and cents and ordinary business, it certainly pays a city to have a low death-rate.

VINEGAR WATER IN TYPHOID FEVER. Some years ago Loir called attention to the fact that 20 grams of vinegar in a liter of contaminated water kills the bacteria in it, including those of the typhoid group, and the same occurs when one-half water and one-half of an acid wine are mixed together. Alvarez¹⁹² is surprised that the use of acid drinks in typhoid and paratyphoid patients is not more extensively used. In his forty years of practice, he attributes the good results he has obtained in typhoid cases from the use of lemonade and diluted wine, and, in recent days, of vinegar water and hydrochloric acid lemonade. He believes that it lessens the mortality and the complications.

THE HIGH CALORIC DIETS IN TYPHOID FEVER. Coleman¹⁹³ has an interesting article on the subject of the high caloric diet, dealing with his experience in 444 patients, one-half on a milk diet and one-half on a more generous feeding. It is exceedingly interesting to note how much better the results are in every way in the patients that are well fed as contrasted with those on the strict milk diet. There is, of course, a possibility that the severity of typhoid may have been somewhat lighter during the period in which the high caloric diets were used, but in any event, the results are striking in many ways. In the first place the mortality is less, and in the second place the convalescence is very markedly shortened, and, apparently, also the length of the febrile period, although the fever itself does not seem to be influenced by the increased feeding. There is a marked general improvement in the general condition of the patient, the condition of the mouth is better, and nausea and vomiting less frequent. It is also noted that tympanites and diarrhea are more frequent in the milk diet. The patients are less nervous, there is less emaciation and a very considerable lessening in the number of complications. Of particular

¹⁹² Siglo médico, Madrid, January 6, 1917, p. 1.

¹⁹³ Journal of American Medical Association, August 4, 1917, p. 329.

importance is the fact that intestinal hemorrhage and perforation are less frequent in the well-fed patients. Recrudescences are less frequent in the high caloric cases, but real relapses show a somewhat higher figure in this same class. Taken all in all, if common-sense is used, there seems to be no question that the better nourishment of the patient represents the better form of treatment.

TYPHOID APPENDICITIS. As early as 1808 Jadelot described a case of appendicitis in a boy with adynamic fever. The first American case was reported by Sand in 1857, and was verified by autopsy. Since these observations there have been a number of reviews in the literature, and Skelton¹⁹⁴ has reported an instance and reviewed the literature of the subject. The combined report from Boston, covering the years from 1853 to 1900, show that there were 328 cases of typhoid with perforation, of which 30 were of the appendix proper or a little more than 9 per cent. Hopfenhausen, in 30 autopsies on typhoid, found every appendix affected, and the conditions varying from simple inflammation to ulceration; and Kelly, in 30 cases studied either during operation or autopsy, found that the appendix condition was marked, in 5 there was evidence of previous ulceration of the appendix, in one there was active ulceration without perforation, 10 perforations, 1 abscess, 4 had simple congestion, and the remaining 7 showed adhesions, flexions, obliterations, and the like. In 119 autopsies on typhoid cases, Christian found 19, or 16 per cent., with changes in the appendix.

It is not strange that in a disease like typhoid with the extensive changes in the lymphoid tissue that the appendix should frequently suffer. The two important points are the diagnosis and the treatment. Skelton states that appendicitis is more often mistaken for typhoid than the converse. He believes that when the appendix trouble comes on in the middle, or late, in typhoid, it is of a less severe type and may easily be overlooked. Fever, of course, is already present and there may be nausea and vomiting, with general abdominal tenderness, which becomes localized over the right rectus and there is also rigidity. In the cases occurring earlier, there may be marked rigidity of the right rectus and drawing up of the right leg, and, at times, retention of urine. The pulse rate becomes more rapid, and then there is nausea and vomiting. The gurgling is usually replaced with a swelling and dullness on the right side. The leukocyte count, repeated every three or four hours, may help to clear up the nature of the condition. In the early cases one has to differentiate between a typhoid with appendicitis, and very simple appendicitis occurring independently of typhoid fever.

The question of what ought to be done is still a matter of discussion. The late Dr. Murphy did not believe in operating on typhoid appendicitis unless there was perforation, whereas Deaver, McBurney, and Worcester believe that the cases should be operated upon. Operations during typhoid fever have a high mortality, regardless of the nature of the operation. It would seem that in the early course of the disease, with a definite diagnosis of appendicitis, the correct procedure would be to operate, but as rapidly as possible and with as little disturbance of the tissues as possible. In cases occurring late in the disease, if the

¹⁹⁴ New York Medical Journal, October 6, 1917, p. 638.

patient's condition is very bad, it has been suggested by several surgeons to leave the wound open for drainage and at a secondary operation after convalescence, undertake the cure of the artificial fistula and hernia. This whole question is one which cannot be settled dogmatically, but each individual case will have to be carefully considered on its own merits.

ALKALINE TREATMENT OF GALL-BLADDER CARRIERS. Nichols¹⁹⁵ suggests that a method of dealing with early gall-bladder carriers including the typhoid group, cholera group, and possibly also dysentery carriers, is to direct the efforts to increase the antiseptic action of the bile, which, for the organisms of the diseases just mentioned, is apparently due largely to the alkalinity, inasmuch as it disappears on neutralization. The reaction of the bile can be influenced by the administration of alkalies. This has been demonstrated on rabbits and also upon human beings. The method suggested has been only tried on 2 cases, one a paratyphoid A carrier; the second, a typhoid carrier. These patients were given 2 grams of sodium bicarbonate three times a day for ten days. In both instances, the carriers cleared up very quickly. As Nichols suggests, these may have been only temporary carriers that might have cleared up anyhow, but the suggestion is certainly worthy of a thorough trial.

The question of treatment of carriers must at once bring up the question of their recognition, and Einhorn has suggested the use of the duodenal tube in diagnosis of this condition of the gall-bladder. This method has been used by Garbat as a means of determining the complete convalescence of typhoid patients. Nichols gives the technic for making the test, as follows:

"At the end of three hours the tube is primed by aspiration with a syringe, which usually produces a small amount of whitish mucus, acid to litmus. This procedure often establishes a siphon, and in another hour yellowish-green fluid, neutral or alkaline to litmus, may be dropping out of the tube. Further suction gives from 10 to 20 c.c. of genuine duodenal contents. If the contents are still acid, a further wait is necessary, and rarely another trial on another day must be made. No special hardship is involved, and one patient took the tube four times. Altogether 28 successful attempts were made out of 32 trials on 25 patients. Endo plates are inoculated as soon as possible, one with the straight fluid and one with the centrifugate. Another portion is put in brilliant green peptone water, 1 to 20,000; and plated on Endo's medium after twenty-four hours' incubation. The centrifugate is also examined microscopically for organisms, crystals and cells. In one case, many active *Lamblæ intestinales* were recovered, while the stool showed only a few cysts.

In general, the contents in all cases were much the same, consisting of a yellowish-green mucoid, slightly turbid liquid, neutral or slightly alkaline to litmus. The specimen therefore differs from the thick brown fluid obtained from a biliary fistula, but the change in appearance is apparently due largely to dilution, which does not affect its suitability for culture. In the centrifugate, amorphous *débris* pre-

¹⁹⁵ Journal of American Medical Association, March 31, 1917, p. 958.

dominates, a few cholestrin crystals are occasionally seen, and also yeasts, cocci and motile bacilli, which cultures show are usually colon bacilli. The two positive cases showed no distinct macroscopic or microscopic evidences of infection, although carriers of longer standing would probably show some pus cells.

Typhus Fever. THE ISOLATION OF THE BACILLUS OF TYPHUS FEVER FROM THE BODY LOUSE. Ever since Nicolle and others demonstrated the part played by the body louse in transmitting typhus fever, observers have been searching for the organism in this insect. In 1910 Ricketts and Wilder described polar-staining organisms found in the intestinal contents of normal lice and in large numbers in infected lice. Similar organisms were found, in 1913, by Hegler and von Prowazek; in 1914 Sergeant, Foley and Vialatte published their observations which were to the effect that in thousands of lice fed on healthy persons or on those without typhus fever, no organisms could be found, but that in typhus-infected lice they found a small polar-staining organism. These observations were confirmed in 1916 by Töpfer, Baehr and Plotz, and others.

Olitsky, Denzer and Husk,¹⁹⁶ in an expedition in Mexico, were able to transmit the disease to guinea-pigs by the injection of typhus-infected lice, and the typhus bacillus has been recovered from the spleen of the infected animals. They were also able to grow the bacillus of typhus taken from the bodies of lice, which had not previously been done, apparently owing to improper technic. The organism, as grown, was identical with the *Bacillus typhi-exanthematici* morphologically, culturally and serologically.

BLOOD CULTURES IN TYPHUS FEVER. Baehr and Plotz¹⁹⁷ made a study with reference to the etiology of typhus fever in Serbia, in 1915, and in Volhynia, in Russia, in 1916. They were able to confirm the observations made in New York that the *Bacilli typhi-exanthematici* is present in the blood during the febrile period of the disease.

These observations were made in 64 individuals, and the bacillus grown in pure culture. In Serbia and Bulgaria, anaërobic cultures were made in 40 cases and the organism isolated in 19, or 47.5 per cent. The number of positive results was undoubtedly interfered with through inability to properly incubate some of the cultures. In Volhynia and Galicia, positive cultures were obtained in 19 of 24 cases, or in 79 per cent. The organism may be found in the blood from the first day of the disease and during the entire febrile period, and it is interesting to know that the intensity of the bacteremia runs parallel with the severity of the disease. In two instances cultures were taken during a chill, in one case at the very onset of the illness, and the blood was found to contain enormous numbers of bacteria.

ANTIBODIES IN TYPHUS FEVER. Denzer and Olitsky¹⁹⁸ made a study with reference to the antibodies in man and guinea-pigs in typhus exanthematicus. Plotz, Olitsky and Baehr, in their splendid study on the etiology of the disease, reported the occurrence of agglutinins, com-

¹⁹⁶ Journal of American Medical Association, April 21, 1917, p. 1165.

¹⁹⁷ Journal of Infectious Diseases, 1917, vol. xx, p. 201.

¹⁹⁸ Ibid., p. 99.

plement-fixing bodies, precipitins, and opsonins in the blood of typhus-fever patients, and all types of antibodies were found regularly after the crisis, occasionally at the crisis, and only rarely before it. The antibodies persisted in the blood many months after convalescence, but in guinea-pigs no antibodies except opsonins could be demonstrated.

The method used in the study of Denzer and Olitsky was that suggested by Dale in the study of anaphylactic phenomena. This method was first successfully applied by Weil in studies on pneumonia. It depends on the muscular contraction of the uterus of a sensitized guinea-pig when brought in contact with the antigen. The uterus is removed and suspended in a container filled with Locke's solution and kept at a temperature of 37° to 40° C. It is attached to a lever which registers on a moving drum. The antigen, when added to the fluid, causes contraction which is recorded on the drum. The contractility of the muscle is tested by using ergamine. Using this method, it is found that antibodies were present in the serum of patients after the crisis, but not during the height of the disease. They were also able to demonstrate that antibodies were present in the cells of typhus-fever guinea-pigs after the crisis, but, as in the case of human beings, not during the height of the disease. The reactions were specific and cannot be produced either by the blood of normal individuals or by the blood of patients suffering with other infections.

This study seems to add further evidence that the organism described as the cause of the disease is really the etiological factor.

IMMUNIZATION AGAINST TYPHUS FEVER. McCoy and Neill¹⁹⁹ have made some observations on the problem of producing immunity in monkeys against typhus fever by use of a vaccine made from the organism isolated by Plotz. Without going into the details of their work, it may be stated that all attempts to produce an immunity were unsuccessful, and that neither living nor dead cultures cause any disturbance of the temperature. The animals were not protected from the disease when doses sufficient to produce infection were given.

EXPERIMENTAL TYPHUS FEVER IN GUINEA-PIGS. Neill²⁰⁰ has made a study particularly of definite, gross, and minute pathological changes in the genitals of male guinea-pigs reacting to Mexican typhus-fever blood. The gross lesions occurred in about 70 per cent. of the animals examined, and depend on lesions of the bloodvessels. These are similar to, but milder in character than those occurring in guinea-pigs with Rocky Mountain spotted fever. About ten days after the intraperitoneal inoculation of guinea-pigs with about 2 c.c. of blood containing the virus of typhus fever, there is a rather characteristic elevation of temperature. The pathological changes had not been studied very extensively before Baehr and his co-workers noted an enlargement and congestion of the spleen with prominent Malpighian bodies, and believed by them to be typical of typhus fever. In similar studies in Rocky Mountain spotted fever the definite lesions in the scrotal tissue were described by Ricketts and other workers, and this led Neill to study lesions in typhus fever in male guinea-pigs. Rocky Mountain

¹⁹⁹ Public Health Reports, June 1, 1917, p. 841.

²⁰⁰ Ibid., July 13, 1917, p. 1105.

spotted fever and typhus fever are not identical diseases, as has been shown by immunological studies.

The lesions noted consisted of a degeneration of the intima of the bloodvessels with a proliferation of the endothelium and connective tissue of the walls. There is pronounced perivascular infiltration, consisting chiefly of lymphocytes and endothelial leukocytes. Polynuclear leukocytes are present, but distinctly in the minority. The changes are particularly present in the small vessels, and there is occasionally thrombosis.

Epidemic Vincent's Angina. Ulceromembranous stomatitis is rather a rare disease, so that the experience of Campbell and Dyas²⁰¹ is of particular interest. Since the beginning of the war the disease has become exceedingly prevalent in France where it is known as *trench mouth*, and is regarded as one of the commonest of the disabilities among the troops. The patients are usually not ill enough to be in bed, but there is marked physical affection and inability to chew the food, which results in a marked lowering of the efficiency.

The organism causing the disease may infect the mouth, throat, or bronchi, and, very rarely, the prepuce. Most of the cases are of the tonsillar type, with a yellowish-gray membrane on one or both tonsils, and an extremely fetid odor to the breath, but not like that of diphtheria. The cervical lymph nodes may be somewhat enlarged and tender, and there may be some little difficulty in swallowing. As a rule there is no headache or myalgia, and the marked prostration seen in diphtheria or acute tonsillitis is not present. There may be slight temperature and occasionally it may reach as high as 103.5° F. A bleeding surface is left on removing the membrane, and, in advanced cases, there is marked ulceration of the tonsil. In other cases there is a deep ulcer on the ramus of the lower jaw immediately behind the last molar tooth, and, when this is not treated, an infection spreads along the lower gums, causing a pyorrhea of the lower gums. In other cases there is simply a pyorrhea, the gums are swollen, spongy, and bleed easily; later, there is erosion of the gum and a free flow of pus, mixed with blood, upon pressure, and the gums are covered with a yellowish membrane. In some cases the tooth may even become loose and fall out. In others, who are undergoing mercurial cures with the resulting mercurial gingivitis, the disease may be met with. There is sometimes general infection of the mouth, with very marked ulceration of the cheeks, fauces, tongue, pharynx and palate, and even the lips, and very marked general symptoms.

In bronchial affections there is a moderately severe bronchitis with a great deal of expectoration and a slight elevation of temperature, which usually lasts for a few weeks. The organisms are found in the sputum, but there are no visible lesions in the mouth or throat. In the cases of balanitis there is usually considerable edema, but these cases cleared up quickly on local treatment.

The diagnosis from diphtheria is made from the examination of swabs from the lesion, but the patients are practically never as ill as they would be with a diphtheria of the same extent. Various antiseptics have been

²⁰¹ Journal of American Medical Association, June 2, 1917, p. 1596.

suggested. In the mild cases iodine, silver nitrate, arsenic, trichloroacetic acid, hydrogen peroxide, tincture of ferric chloride, and potassium permanganate may all be used with success. Arsenic is one of the most effective preparations. Deep ulcers are first swabbed with silver nitrate solution, and subsequently, four or five times a day, with liquor potassii arsenitis. In the severer cases the administration of arsenic, or the use of sodium cacodylate hypodermically, is to be advised. In the cases with pyorrhea, Bowman has suggested a tooth-wash composed of one-half ounce of wine of ipecac, one dram of glycerin, and sufficient liquor potassii arsenitis to make an ounce. A few drops three or four times a day on a tooth brush.

Weil's Disease. Last year I called attention to the work of various observers on this subject, pointing out that the *Spirochete icterohemorrhagica* had been demonstrated in Japan and also in Flanders, and I commented upon the observations made on animals, particularly the guinea-pig. Kaneko and Okuda²⁰² have made a study of the distribution of the spirochete in the human body. Inada and Ido²⁰³ divide the disease into three clinical stages, the febrile, the icteric, and convalescent. The febrile stage continues for six or seven days during which time there is, in addition to the fever, intestinal disturbances, headache, muscular pains, hyperemia of the conjunctivæ, and albuminuria. The blood during this stage is pathogenic for guinea-pigs. Their distribution is very much like the disease as produced in the guinea-pig and their organism is present in large numbers in the kidney, liver and adrenals. They are rarely found in the liver after the seventh day, and the same is true for the adrenals. During the icteric stage, from the seventh or eighth to the twelfth or thirteenth day of the disease, more properly than at its height, the spirochete apparently disappear from the blood and are destroyed in the organs, but they may be found in the kidneys and cardiac muscles in small numbers, sometimes in the muscles and walls of the intestine and in other epithelial structures. The convalescence generally begins between the thirteenth and sixteenth day, and at this time the immune bodies are fully developed and the spirochetes are being abundantly excreted in the urine. They persist longest in the kidneys.

THE RAT AS A CARRIER. Ido, Hoki, Ito and Wani²⁰⁴ have reported on their observations on this subject. In his investigations on the tsutsumushi, or Kedani disease, noted elsewhere in this review, Miyajima called attention to the fact that, in his investigations, spirochetes resembling the *icterohemorrhagica* were found in the kidneys of the field mouse. Following up this suggestion, the authors made a study of house and roof rats, *Epyomis alexandrinus* and *Epyomis norvegicus*. In one animal they found the organism in the kidney. In the spring of 1916 Miyajima again reported that in the field mouse he had isolated a spirochete which, when injected into guinea-pigs, produced a spirochete, and, after a number of generations, icterus. The immune serum of Weil's disease destroyed these organisms, so he concluded that this spirochete was identical with that of Weil's disease.

²⁰² Journal of Experimental Medicine, September, 1917, p. 325.

²⁰³ Ibid., 1917, vol. xxvi, p. 355.

²⁰⁴ Ibid., September 1, 1917, p. 341.

Stokes, Ryle and Tytler²⁰⁵ were able to demonstrate the *Spirochetes icterohemorrhagica* in the kidneys of field rats and infected guinea-pigs with the organisms. Without going into greater detail with regard to these observations, it would seem that the extermination of rats and field mice is a highly important prophylactic measure against the disease. The Japanese authors just quoted have also brought out another interesting point, namely, that the regions in which the disease occurs rarely have an acid soil, while it is endemic in alkali and neutraline soil, so that the composition of water and soil must play an important part in the development and spread of the disease. Inada²⁰⁶ has also an interesting contribution on the clinical aspect of the disease.

Quite a number of observations have been made in Italy during the past two years, but, fortunately, most of the cases that have occurred among the Italian troops seem to have been of a mild type. Among the various contributions is an excellent article by Carpi.²⁰⁷ In addition to the clinical history of the cases, he outlined his experiences with animals, and believes that in the absence of an effective serum that the cases are best treated by arsenic or mercury, or a combination of both. In the cases in which both drugs are administered, he noted that there was a rapid improvement of the general condition, with a diminution of the icterus and also of the swelling of the lymph nodes, liver and spleen when these were present.

Another extensive study is by Moreschi²⁰⁸ and by Micheli and Satta.²⁰⁹

THE SPIROCHETE ICTEROHEMORRHAGICA IN AMERICA. This organism, which is the cause of infectious jaundice, such as frequently occurs among troops in barracks, among sewer workers and rice planters, and which had been described by a number of observers long before the organism was discovered, by Larrey and Ozanam in 1849, and others, and by Weil in 1886, whose name the disease very frequently bears. In 1914 Inada and Ido transmitted the disease to guinea-pigs by inoculating them with the blood of patients suffering with it, and described the organism which has since proved to be without doubt the cause of the disease. Noguchi²¹⁰ has studied wild rats captured in this country and found in their kidneys spirochetes which have the same morphological and pathogenic properties that characterized the organism as described by Inada and subsequent workers. The disease has also been described and the organism isolated in Belgium, and all three strains, American, Belgian and Japanese, have been cultivated, the first two artificially for the first time by Noguchi. It has been definitely proved that animals immunized against the Japanese strain resist both the Belgian and American strain, and the same is true of the Belgian organism, and an experiment to ascertain whether the American strain also protects against the other two is now in progress. It would seem, from the evidence brought forward, that all three are the same. On account of its distinct features, Noguchi's new genus has been suggested which he calls the *Leptospira*.

²⁰⁵ *Lancet*, vol. cxvii, p. 142.

²⁰⁶ *Journal of Experimental Medicine*, September, 1917, p. 355.

²⁰⁷ *Il Policlinico Sezione Pratica*, July 9, 1917, p. 949.

²⁰⁸ *Ibid.*, February 25, 1917, p. 267.

²⁰⁹ *Ibid.*, p. 268.

²¹⁰ *Journal of Experimental Medicine*, 1917, vol. xxv, p. 755.

Antitoxin for *Bacillus Welchii*. Bull and Pritchett²¹¹ have found that under certain defined conditions a bacteria-free toxic substance may be obtained from the *Bacillus welchii*, and that this is an exotoxin and is capable of producing all the essential lesions and effects of infection with the organisms. They also determined that animals that have received a graded number of doses of the toxin yield an immune serum which neutralizes *in vitro* all the pathological effects of the toxin, and exhibits power to control infections with both the spore and vegetative forms of the bacilli. The antitoxin which they made was prepared in a horse, the subject of the preparation and standardization being left to a later publication.

Bull²¹² has reported on his further observations, and he thought that guinea-pigs may be passively immunized by the administration of the antitoxin and that this immunity lasts about two weeks. The pigs that had received the prophylactic dose of antitoxin showed a pronounced resistance to infection with the virulent bacilli for twelve days. Guinea-pigs which had been previously immunized, and in which the infection had become established, were given antitoxin, and the infection could be either arrested or controlled. Bull is of the opinion that it will be possible to prevent the infection with the *Bacillus welchii* in man with the prophylactic use of the antitoxin and to prevent the infection after it has occurred by injection of therapeutic serum. If these observations are correct and can be substantiated, and there seems to be no doubt that they will be, this will mark one of the most important therapeutic discoveries of recent times, and the antitoxin for this organism will doubtless take its place along with the diphtheria and tetanus antitoxins.

Whooping-cough. EARLY DIAGNOSIS OF WHOOPING-COUGH BY CULTURES. Chievitz and Meyer,²¹³ in Copenhagen, made a study of the cultures made from the sputum of whooping-cough cases during the catarrhal stage, and were able to isolate the organism in practically all cases. Where they could not secure the sputum, and in very small children, the patient was allowed to cough against plated culture media held a few inches away from the mouth. This method of diagnosis is one that takes considerable skill and labor. When the plate method is in use, the sputum is washed out in sterile salt solution and then rubbed over the surface of blood-potato agar. After an incubation period of about four days, little points of the colonies appear, suggesting minute drops of mercury. Under the microscope it is impossible to differentiate between these organisms and the influenza bacillus, so that the final test is made by the agar test with the serum of rabbits or horses immunized with the *Bacillus pertussis*. After four weeks the cultures are usually negative, and the Danish regulations allow the patient to go about freely after four weeks, provided there are two negative cultures. This would seem to be an unusually valuable method of making an early diagnosis, and so preventing the infection of a great number of children, particularly in schools.

²¹¹ Journal of Experimental Medicine, 1917, vol. xxvi, p. 119.

²¹² Ibid., 1917, vol. xxvi, p. 603.

²¹³ Ann. de l'Ins. Pasteur, vol. xxx, p. 903.

DISEASES OF CHILDREN.

By FLOYD M. CRANDALL, M.D.

FOR two years past I have had occasion to mention a peculiar feature marking pediatric literature. War conditions have rendered material available from foreign sources very meager. Conditions in this respect are even more marked than they have been during preceding years, owing apparently to more serious conditions in Europe. Military medicine and surgery have occupied much space in medical journals, and few subjects have suffered more than pediatrics. Year by year, for three years past, it has been necessary to draw the material for these articles from American sources. No serious epidemic has occurred during the past year and no one subject has received particular attention. Less has been written upon infant feeding and infant foods than at any time for many years. Pediatric work, however, has not been at a stand-still and much has been written upon children's diseases and the preservation of child life.

Owing to the destruction of adult life the nations have awakened to the importance of preserving child life. Infant welfare endeavor has markedly increased, with the result that the mortality of early life has markedly decreased in all the nations engaged in the great war. It is one of the good results that have followed the many evils of the past three years. Efforts toward prevention of disease in early life and the conservation of infant life have received a great impetus.

Dr. Jacobi,¹ whom the medical profession has long held in honor, and upon whom the pediatric portion of the profession looks as almost the founder in America, has written this year a series of articles on the history of pediatrics in New York. It is an admirable historical review of pediatrics of impersonal nature up to the time of Dr. Jacobi's advent into medicine. Beyond that time the articles bear more or less of the personal stamp. Not only has much of pediatric history been made by him, but his knowledge and personal acquaintance render anything that he writes of peculiar interest. It is impossible to abstract an article of this character, but it seems only just, in view of the great contribution of Dr. Jacobi to the department of pediatrics, to give tribute to this the most recent of his works.

While Dr. Jacobi's article is devoted to pediatrics in New York, there is an interesting feature presented to the reader. During the earlier periods it seems true that much of the history of this specialty in this country was made in New York. In recent years this cannot be said. Other centers have contributed some of the most valuable additions to

¹ Archives of Pediatrics, January, February, and March, 1917.

our knowledge of children and their diseases. New York has kept the pace, and it is in the front ranks, but there are others in the front ranks with it.

An article entitled, "A Pediatric Center in New York City" by Chapin² shows why New York should of necessity be a center for this and other specialties. At the time of his writing the estimated number of children under sixteen years of age in the city was 1,699,901. The New York profession is certainly not restricted for material. This population is the most cosmopolitan of any city in the world. The death reports of the Board of Health show 28 distinct nationalities, which does not include certain unknown and mixed nationalities. Sixty-four hospitals make more or less provision for the care of sick children, 2469 beds being assigned to them. These beds are mostly assigned to infants. This does not include the beds devoted to orthopedic cases and the diseases of older children. Seventy-six dispensaries have departments for the treatment of children, and there are thirteen asylums and homes for infants. In spite of the dense crowding in certain areas the death-rate among children is extremely low, owing largely to the attention that for years has been devoted to their welfare. The death-rate under fifteen years was 14.68. Such a ratio as this speaks volumes for city administration and professional proficiency.

An interesting article on the relation between pediatrics and general medicine is written by Chapin.³ For years the medical colleges maintained a chair upon diseases of women and children. While the personal relations between women and children are close, their diseases have nothing in common. It required years of education to demonstrate the absurdity of combining these two important specialties of medical practice. Pediatrics is more closely allied to general medicine than with any other department of practice. In many of its features it is allied to internal medicine, neurology, and orthopedic surgery. It touches in a less degree many other departments of practice, such as those devoted to the skin, throat, eyes, ears, and the various infectious diseases.

The Effect of Civilization upon Children's Diseases. A series of three most interesting papers⁴ is collected in a symposium dealing with the effects of civilization upon diseases of children, diseases of adult life, and diseases of middle life. The article upon children's diseases as they have been modified by civilization is by Freeman, of New York, a most competent authority. He asserts that the influence of civilization on morbidity and mortality in infancy and childhood should furnish most amazing data could the actual morbidity and mortality of uncivilized races be obtained. Such races furnish some hygienic conditions not found among the civilized. They live more in the fresh air—that is, they have poorer facilities for excluding fresh air from their habitations than have civilized nations. Their occupations being manual, they should furnish more perfect development for the propagation of their progeny, and the mothers should be better able to nurse their babies than the women

² Archives of Pediatrics, January, 1917.

³ Journal of American Medical Association, July 14, 1917.

⁴ Medical Record, July 28, 1917.

living under civilized conditions. Such mothers are free from the confining duties of the modern mother.

On the other hand, adverse conditions exist that far outweigh these advantages. The absolute lack of medical care, the inability to provide proper artificial feeding in case of lack of breast milk, the unsanitary surroundings, with the opportunity for sputum and fecal contamination, and the uncontrolled spread of disease, for in many epidemics children are more susceptible than adults. It will be recalled that in Koch's investigations in Africa he was able to obtain an index of the amount of malaria in any community by examining the blood of a certain number of children.

In distinction from this condition of things we can say that the intelligent and efficient administration of any community now may be judged from its infant mortality. It has recently been stated by a Roumanian physician that the infant mortality is 50 per cent., that is to say, that one-half of all the children born in Roumania not long ago died before the end of the first year. More than one-fourth of all the babies born in New York died within the first year, and it is only since the government of the city has been taken out of the hands of corrupt political bodies and administered by intelligent officers that this mortality has materially decreased.

In Russia, before the war, the infant mortality is stated to have been 26 per cent. The infant mortality before the war was higher in the Central Empires than among the allied powers of Italy, England, and France. The infant mortality of Austria-Hungary was 22 per cent. and of Germany 19 per cent.; while in Italy it was 17 per cent., in England 12 per cent., and in France 10 per cent. In France, infant life has been a source of particular care on account of the rapid diminution of the birth rate.

The infant mortality of this country has never been obtainable on account of the fact that in a considerable portion of the country the births are still not registered.

In New York City the infant mortality for three years has been less than 10 per cent., and this is better, probably, than in any European country excepting Sweden, where the mortality is 7.5 per cent. This low mortality in New York City has been obtained through the efficiency of the Board of Health, the multiplication of milk depots and other agencies for the proper education of mothers in the tenements, to the gradual improvement of the milk supply and of hygiene and housing in the city.

Civilization, with its accompanying medical research and rapidly increasing knowledge, is producing results in the morbidity of children that could not have been expected. Thus infant mortality must have been materially diminished at the time vaccination was introduced and its accompanying elimination of smallpox from the material causes of death. In more recent years the knowledge of the causation of malaria by mosquitoes has stimulated the drainage of stagnant water, which has eliminated to a large extent, from well-administered communities, the death of infants from malaria.

Probably our most effective exhibit in the reduction of infant mortality is in the deaths from diphtheria. A death-rate of 32 per 1000 in 1894 in New York City was reduced to 3.5 in 1909 and 0.125 per cent. in 1916. There is therefore only 1 death where in 1894 there were 256.

The mortality from pneumonia is being diminished, but not by the use of specific sera, for, unfortunately, the pneumonias which are amenable to such treatment are very rare in children. The reduction of mortality from this disease therefore is attributable to rational methods of treatment, the rapid emptying of the stomach and bowel contents and the free access to fresh air. The ordinary mortality of pneumonia in children treated in hospitals is given in text-books as from 30 to 50 per cent. By the use of the outdoor treatment at the Roosevelt Hospital, Freeman obtained, in 21 successive uncomplicated hospital cases of lobar pneumonia, a death-rate of 4.7 per cent.; and in 31 successive uncomplicated cases of bronchopneumonia, a death-rate of 3.3 per cent.

By the same method of treatment and the securing of sanitary quarters, so far as possible, the pulmonary tuberculosis death-rate in New York City has diminished in the past six years from 2.37 per cent. to 1.5 per cent.

The same sanitary methods have apparently influenced other diseases for which we have discovered no specific cures. Thus we find that the death-rate from measles has decreased from 0.16 to 0.09, and that from scarlet fever from 0.2 to 0.02 per cent. These latter figures may be due to a milder character of the epidemics, but it seems probable that they are all due to better hygiene and care.

Infant Welfare Work in War Time. The war situation is having a certain effect in pediatric literature. The conservation of infant life in the rush and turmoil of war has not been forgotten in the countries most affected. It should certainly not be neglected in America. The saving of life and the replacing of lives lost is occupying the thought of every nation involved in the great struggle. An extended review of the measures adopted in Great Britain, France, Belgium and Germany is presented by Grace L. Meggs,⁵ of Washington. It shows how, in the presence of war, other countries have taken measures for the protection of maternity and infancy and offers many practical suggestions as to measures which should be taken in the United States with the same end in view.

The war makes immediately indispensable in this country such palliative measures as the increase of day nurseries or the supervision of pregnant women working in factories, to which dire necessity has driven certain foreign countries. Study is necessary to show how present and future industrial and economic conditions will affect the number of pregnant women and mothers of young children employed in factories, and what measures are needed under these conditions.

The chief preventive measures for protecting babies is to ensure their intelligent care and nursing by healthy mothers in their own

⁵ Journal of Diseases of Children, August, 1917.

homes. The disorganization of welfare work, through the loss of physicians and nurses especially trained for it, is an imminent danger, and should be avoided if possible. In view of the greater demand for nurses, every effort should be made to enlist a large number of candidates for hospital training. The preventive work for infant and maternal welfare, already established, should be strengthened and extended, and nothing should be considered more important in war time.

This question of child welfare has received the attention also of the General Medical Board of the Counsel of National Defense. Early last spring it sent out letters to various organizations, requesting them to make various recommendations indicating in what way they could be of service in the present national crisis. In accordance with this request, representatives of various organizations interested in maternal and child welfare met in committee at Washington in June, formulated recommendations and sent them to the Medical Board. A glance at the list of societies represented on this committee shows the widespread nature and distribution of the associations interested in infant and child welfare. On the committee are represented not only medical societies and specialists, but also public health and social organizations dealing with these problems. The chief object of the committee was to make, on a broad, comprehensive scale, recommendations and suggestions looking to the protection and preservation of the child life of the nation during the war. The recommendations, obviously, must be of a general nature. Their practical application must be left to the individual community, according to the peculiar local conditions of that community.

The report enumerates eighteen propositions which it recommends, which may be found published in full in the *American Journal of Diseases of Children* for July, 1917, by those who may be interested.

Diathesis in Childhood. There has been a tendency in recent years to ignore diathesis, and concentrate attention upon the more tangible causes of disease. It is sometimes forgotten that a soil is as necessary as a seed. It must be said that there has been some reaction in this direction, and more attention has been given to the inherent weakness of the patient, and the fact that germs are not the only factor in the causation of disease. More thought is certainly given to diatheses and predisposing causes, but the classifications of a few decades ago have been greatly modified. An excellent article on the subject is that of Epstein,⁶ of New York. He refers to several constitutional types, of which the following is a summary:

GENERAL CONSTITUTIONAL DIATHESES. This is a general bodily weakness, a universal asthenia, that is, a weak body in which a feeble life resides. This constitutional inferiority may be an unhappy inheritance from a former generation, or it may be acquired early in life as the result of poverty, faulty nutrition, or bad hygiene. The asthenic child shows a general subnormal development without any definite cause. The child may be late in holding up the head, standing, walk-

⁶ Medical Record, June 30, 1907.

ing, talking, and dentition. The entire skeleton may be delicate; the thorax, long and narrow and of the status phthisicus type; the abdomen, long, narrow, and of the habitus enteroptoticus type. There is usually a delicate, transparent skin, with a general flaccidity or atony of the muscles. The child is subject to indigestion, poor appetite, frequent colds, and poor sleep. There may be atonic or functional murmurs, and a low blood-pressure. As a rule the asthenic child is mentally bright, but does not thrive physically.

METABOLIC DIATHESIS. Some children manifest an intolerance for protein, fat, or carbohydrates. Others show a disturbed relation between the anabolic and the catabolic processes of the body or some abnormality in the chemical changes that take place in the living tissues giving rise to the various nutritional or constitutional diseases. Obesity or hypernutrition is a metabolic disorder which may manifest itself in early life. In the majority of cases, obesity is an inherited diathesis. It is probably due to a suboxidation in the tissues, to a disturbed metabolic equilibrium, or to overfeeding. The excessive increment of bodily substance usually produces in the child sluggishness of action, disinclination to muscular exercise, constipation, palpitation, and dyspnea on exertion. The treatment is mainly dietetic. A child showing a tendency to obesity should not receive more food than is necessary to cover the caloric requirement. Farinaceous food should be restricted and muscular activity encouraged. The uric acid diathesis leading to gouty arthritis and renal calculi later in life may have its beginning in childhood. Diabetes mellitus and diabetes insipidus may be present in childhood or their diatheses may be acquired in early life. Rickets, with its many complications and sequelæ, is frequently seen in childhood as the result of some metabolic diathesis.

HEMORRHAGIC DIATHESIS. Leaving out of consideration hemorrhages due to ulcerations and erosions, and the symptomatic hemorrhages which are the result of various infections or toxic diseases, there is a group of hemorrhagic conditions the cause of which is not definitely known. There is simply a tendency to spontaneous hemorrhages from many parts of the body or to excessive bleeding following a slight trauma. The blood, the blood platelets, and the bloodvessels have been found to be abnormal. Hemophilia is an inherited hemorrhagic diathesis which is usually transmitted from male to male through the medium of the female who acts as an immune carrier of this diathesis. Since children are so frequently operated on for tonsils and adenoids, their bleeding history should be obtained. A course of calcium lactate and an injection of blood serum should be given before any operation on a child who is suspected of being a bleeder. Scurvy is a hemorrhagic diathesis of childhood. Scorbutic children have an underlying tendency to spontaneous bleeding when some metabolic or nutritional disorder acts as an exciting cause. Fresh sir, a variety of fresh food, and fresh fruit juices will cure this disease.

LYMPHATIC DIATHESIS. Lymphatism or status lymphaticus or status thymicolymphaticus is a general hyperplasia of the lymphatic system. The tonsils, the thymus, the spleen, and the superficial and

deep lymph glands may be enlarged. Hypertrophied or hyperplastic tonsils and adenoids, so frequently seen in children, may be looked upon as part of a general lymphatic enlargement, and because of their frequent recurrence after operation, tonsillectomy should not be done without very good reason. Thymic stridor and thymic asthma are occasionally seen in children. The possibility of the so-called thymic death, which occurs suddenly in some children affected by the lymphatic diathesis, should always be borne in mind, especially during operations. There is no specific treatment for the lymphatic child. A dry, equitable climate, good hygiene, and proper food, together with Fowler's solution and syrup of ferrous iodide, may be of benefit. X-ray treatment for the large thymus may have a beneficial effect.

EXUDATIVE DIATHESIS. This is a derangement of childhood which manifests itself by some abnormality of the skin, mucous membrane, lymph glands and general nutrition. The exudative child is subject to eczema, urticaria and other skin affections. There is a great tendency to frequent attacks of bronchitis, asthma and catarrhal inflammations of the gastro-intestinal mucosa. It usually occurs in overfed children and is probably the result of an auto-intoxication. Unless the underlying exudative or toxic diathesis is recognized, treatment of the various manifestations of the skin and mucous membranes will do little good. The exudative child should not be overfed and the sugar and fats should be restricted.

NERVOUS OR SPASMOPHILIC DIATHESIS. The nervous system of the child is the least stable of all the systems of the body, and is therefore the most frequently disturbed. Local spasms, ties, fits, laryngospasm, asthma, pyloric spasm, spastic constipation, nervous diarrhea and general convulsions are not infrequent in children. Psychasthenia, hysteria and neurasthenia may also have an underlying congenital or acquired nervous diathesis.

ENDOCRINE DIATHESIS. Alterations in the internal secretory glands may be congenital or acquired. One or more glands may become abnormal or their synergic or antagonistic functions may be disturbed. Abnormality in the secretory activity of the glands may give rise to various pathological changes in the growth and development of the child or to a group of symptoms and signs which are as yet difficult to interpret.

In an article upon the same subject, Caille⁷ gives the following admirable definition: "Diathesis may be defined as a bodily condition or constitutional anomaly which predisposes to other pathological conditions. Some are inherited, others are acquired; both may be overcome by reconstructive effort, hence the importance of their clinical consideration." He designates ten types of diatheses as follows: (1) Asthenic diathesis—this, as its name indicates, often represents the sins and mistakes of former generations; (2) scrofulous, strumous or, as it is sometimes called, the exudative diathesis is one affecting largely the lymphatic system; (3) the spasmophilic diathesis is a term used

⁷ Archives of Pediatrics, July, 1917.

in connection with children prone to convulsions, tremors, fits, tics and night terrors. Other diathesis are (4) lymphatic; (5) cholesterin or gall-stone diathesis; (6) the vagotinic; (7) arthritic; (8) lithemic or uric acid diathesis; (9) the rheumatic or choreic diathesis; (10) the hemorrhagic.

Acidosis in Children.—According to Fergus Hewat,⁸ when acetoacetic acid is detected in the urine, two obvious indications for treatment arise: To stop the formation of the abnormal acids, and to neutralize the acids already present. In children the condition may be met with in connection with some trivial illness, or with urgent symptoms. In an ordinary so-called bilious attack a saline purge or vegetable laxative and an enema are given. An ordinary soap-and-water enema, followed by a saline wash-out, is perhaps the best method of relieving the large intestine. This is followed by a simple alkaline mixture and dextrose added to the diet, which may require to be albumen water or whey, for twenty-four or thirty-six hours. Later, oatmeal gruel is useful. In severe cases in which there is intractable vomiting, the lower bowel must be unloaded and a 5 to 10 per cent. glucose solution slowly introduced by means of a long tube. Sodium bicarbonate may be dissolved in this. Warm water, well sweetened, with 10-grain doses of bicarbonate, is given by the mouth. If this is vomited, repeat it frequently and apply hot fomentations to the abdomen. As soon as the vomiting abates, give albumen water with dextrose.

Cyclic Vomiting with Acetonemia. A case is reported by Parks Weber⁹ of a girl, aged seven years, who is said to have vomited at birth, and had recurring attacks of vomiting lasting three or four days, with intervals averaging five weeks between the attacks. The other members of the family—three sisters and four brothers—were not affected. The urine reduced Fehling's solution very slightly, but gave a positive reaction for acetone and diacetic acid. She was treated with sodium bicarbonate, which soon rendered the urine alkaline, but the reaction for diacetic was not negative until the fifth day. A second attack occurred about three weeks after she had been discharged from the hospital. This attack was preceded by a feeling of lassitude and sleepiness lasting one day. Six hours after the vomiting commenced, the reactions for acetone and diacetic acid were negative. About eight hours after the first urinalysis both reactions were positive. The reactions were not negative until the fourth day. The affection seems to occur more often in girls than in boys, and usually between the age of two and twelve years. It may occur in more than one child of the same parents. The occurrence of migraine in other members of the family has been noted. It is possible that the mental symptoms—drowsiness and lassitude—mentioned in this case may after puberty become transformed into migrainous attacks. Pyrexia in these cases is not common, the temperature rarely exceeding 100° F.

⁸ Practitioner, May, 1917.

⁹ British Journal of Diseases of Children, March, 1917.

The Nitrogen Partition in the Urine of Normal Children. An extensive study on this subject is reported by Johnston and Veeder,¹⁰ of St. Louis. An attempt was made to establish normal figures for the normal partition of nitrogen in the urine of two groups of healthy children. One group was fed on an ordinary, or standard, diet containing meat and vegetables, with the quantity regulated by age periods. The second on a creatin-creatinin-free diet in which the quantity of food (and hence of nitrogen) was regulated according to body weight. In both groups the N partition was practically the same, with the exception of the uric acid nitrogen. Urea N makes up from 80 to 85 per cent. and ammonia N from 3 to 5 per cent. The combined figure for the two is less than 90 rather than above 90, as in adults. Creatin is constantly present, as is creatinin. The two combined form a smaller percentage than the creatinin alone in the adult. The amount of undetermined or "rest" N is high in children.

Phenolsulphonephthalein Elimination in Infants and Young Children. Since the original publication, in 1910, by Rowntree and Geraghty of the results of their experimental work with phenolsulphonephthalein in determining the functional capacity of the kidney, the value of the test has received such ample confirmation as to establish it among the essentials for careful diagnosis in renal diseases. Gittings and Mitchell,¹¹ of Philadelphia, after careful investigation of the subject, confirm the observation that the elimination of phenolsulphonephthalein is not markedly increased in any disease other than renal. Even the youngest infants and children show about the same capacity for phthalein elimination as do adults. Preliminary catheterization, in the absence of the retention of urine, is unnecessary.

For purposes of comparison a uniform technic should be adopted and maintained. In children a single collection, exactly two hours after the injection into the lumbar muscles of 6 mg. of phthalein, should be the method of choice. The necessity for continuous or repeated catheterization thereby would be avoided. An entirely different standard must be adopted for the accelerated output resulting from intravenous injections. The latter need only be employed when local conditions, such as marked edema, prevent the use of the intramuscular route.

Luetic Nephritis in Infancy and Childhood. In reporting some careful studies upon this subject, Butterworth,¹² of New Orleans, says that not infrequently instances of nephritis are met with in infancy and early childhood for which no etiological factor other than congenital lues can be reasonably ascribed. A search of the literature shows that apparently little recognition is given to luetic nephritis by American and English writers. More than twenty-five years ago French writers gave it a distinctly clinical etiology in the nephropathies. German writers have studied the subject from both the clinical and pathological side and have made painstaking and extensive contributions to the literature. Lately,

¹⁰ American Journal of Diseases of Children, May, 1917.

¹¹ Journal of American Medical Association, September 17, 1917.

¹² Archives of Pediatrics, June, 1917.

Italian observers have made valuable additions to our knowledge. Karvonen's exhaustive summary and work in 1900 gave stimulus to further clinical observations. While there is a lack of agreement in regard to the severity of the syphilitic infection and its effect on the kidneys, upon two points there is a more complete understanding. (1) The clinical symptoms of nephritis in hereditary syphilis may be wanting or so insignificant as to pass unnoticed; repeated examinations of the urine may be necessary to establish a diagnosis; (2) if the child survives the early period of life, then the clinical manifestations are those commonly associated with a chronic intestinal nephritis. From his own clinical experience and from a study of reported cases, Butterworth concludes that congenital luetic nephritis presents nothing unusual in its clinical manifestations and that each case is modified by its own individuality, and conforms more or less to certain classifications or types, as follows: (1) Acute parenchymatous nephritis, which may be hemorrhagic; (2) acute intestinal nephritis; (3) chronic intestinal nephritis; (4) myeloid degeneration; (5) gummata of kidney.

Fetal syphilis may result in various kidney changes, such as congenital malformations, cystic kidney and nephritis. Infants and children who present evidences of a heredosyphilitic nephritis during life usually do not show gross macroscopic changes in the kidneys. However, almost without exception, abnormal and characteristic histological findings are found in these cases. Several observers have recently demonstrated active, well-formed *Treponema pallidum* in the vascular, interstitial and parenchymatous renal tissues. The cells of these tissues, when attacked by the treponema, present a progressive phase of cell degeneration. The organism may be found generally diffused throughout the kidney or be localized.

These observations support Karvonen's toxic theory and form reasonable hypothesis for the complex clinical manifestations and diverse urinary findings in the kidney change of hereditary lues. A preponderance of organisms either by the vascular, interstitial or parenchymatous tissue, combined with the extent of involvement and with a diffusibility or localization of organisms, may explain the individual tendency to certain types of nephritis. Living, active *Treponema pallidum* have been found in the urine of a four months baby which died of congenital syphilis. The urine of congenital syphilitic children contains a specific poison, probably an alkaloid, which, when injected into animals, causes death. Castaigne, in 1913, called attention to a familiar albuminuria dependent on hereditary syphilis. He reported 12 personal cases of albuminuria in children. These occurred in four families. All had positive Wassermann reaction. Two of the children died of nephritis. The other 10 were apparently cured by specific medication.

Congenital syphilis is often not the only cause of family albuminuria. Judicious specific medication is curative in most of the cases. Congenital luetic nephritis is not generally recognized as having a distinct etiological basis.

Secondary Anemia Treated by Blood Transfusion.—Eight patients suffering from simple secondary anemia or from anemia and malnutrition

were treated by Kerley,¹³ of New York, by transfusion. Before coming under his care, various food combinations had been tried, and all had received medical treatment for the anemia. The transfusions were made at the Babies' Hospital. The blood of the donor was proved fit by the absence of agglutination and hemolysis. The technic employed consisted in cleansing and cocainizing the skin over the median basilic vein of the child's arm and exposing about 2 cm. by dissecting it free from the surrounding tissues. A small opening was made into one side of the vein with a pair of scissors and a Lindeman needle was inserted. The vein below the needle was then tied off and another suture was placed over the vein and needle to hold the needle in place. A small amount of sterile salt solution was introduced to make sure that there was no leakage. A rubber tourniquet was placed upon the arm of the donor and the skin was cleansed over the most prominent vein, and the blood drawn with a Ricord syringe until it was full. This syringe was then handed to the operator who was working on the child and the blood was inserted into the child's vein. At the same time a fresh syringeful of blood was being obtained from the donor. Each syringe was well washed out with salt solution before being used again to collect blood. This procedure was continued until the required amount had been transfused. The results were shown by a chart. There were 8 cases in the series, and the blood examination before and after the transfusion showed the effect of each transfusion. The results in all but one of these cases were satisfactory. In the other cases there was no return of the anemia, and subsequent growth and development was all that could be hoped for. The children were all under two years of age. The weight increased and the blood findings were tabulated. The table, Kerley asserts, could not record the magical change in the patients, the change from sickly, whiny infants into happy, apparently well infants. These patients were transformed from those with a digestive capacity barely able to maintain existence into those that took on the normal constructive processes of early life.

The Influence of Vitamins is discussed by Louis Fischer.¹⁴ The term vitamin is used to designate the group of substances in the animal diet which are present in minute traces, whose nature and chemical constitution are unknown and whose absence will result in a series of pathological changes which can only be overcome by the addition of these essential factors. Fischer believes that we should not wait for the appearance of rachitic symptoms in infantile development, but that some form of vitamin should be added when the infant is three months old. Three symptoms may be taken to indicate need of vitamins: (1) restlessness, irritability, loss of sleep; (2) greenish, liquid stools containing curds or mucus; (3) stationary weight or loss of weight. In addition to a proper mixed diet of vegetables, fruit juices, fresh milk, fresh meat, or hard-boiled yolk of egg, benefit may be derived from the administration of from 10 to 60 drops of autolyzed yeast at each feeding.

Pancreatic Vitamin in Marasmus. Vitamin was first isolated from rice polishings in 1911 by Casimir Funk, and shown by him to be the agent

¹³ Archives, June, 1917.

¹⁴ Medical Record, July 7, 1917.

which prevented beri-beri. It was also in this year that Mendel and Osborne did their work on the feeding of single purified proteins to white rats. In the latter work it was established that, in addition to nutrients, the diet of a growing rat demanded the presence of certain substances hitherto unknown which these workers found present in protein-free milk and in centrifuged butter fat. Funk had meanwhile not only extended his isolation of vitamin to other substances than rice polishings—among them yeast—but had shown that, aside from the effect on polyneuritic conditions, the vitamin is an essential factor in growth stimulation. From these beginnings, the importance of vitamin as a growth factor has been rapid.

Of recent studies, those of E. V. McCollum,¹⁵ of Wisconsin, and his co-workers, Eddy and Roper, deserve most attention. McCollum summed up the dietary factor as follows: In addition to a suitable nutrient content, a growing animal demands in his diet: (1) the presence of a "fat-soluble A" (the name for Mendel's butter fat factor); (2) the presence of a "water soluble B" (the name for Funk's vitamin); (3) the absence of any toxic factors.

Experiments have shown that whatever the composition of vitamin it is probably not a simple amin. The nomenclature problem would be easier to settle if the substance had been satisfactorily identified chemically. Unfortunately, all attempts to purify it or to isolate it in an approximately pure form have resulted in failure and in loss of power on the part of the vitamin-containing factor. This result has given rise to certain controversies and hypotheses that tend to confuse the general student of the subject.

Eddy has before described a method of isolating pancreatin vitamin. From further study he believes that the use of pancreatic vitamin seems to promise definite hope of success as an agent for stimulating the growth of marasmic children. Hess has shown a similar effect of yeast vitamin, but results do not, as yet, permit of conclusions as to the relative merits of the two sources of vitamins. The dosage is not yet satisfactorily worked out and the conditions under which the effect is produced are not yet defined. These various features are under investigation and the results presented above are given as a stimulus to further work, rather than as conclusive evidence.

Hypertrophic Stenosis of the Pylorus in Infants.—This condition has occupied considerable space in pediatric literature for several years. One of the most recent and authoritative articles upon the subject is that of Holt,¹⁶ based on 141 observed cases. After an extended review of recent literature, he draws a clinical picture which is most striking. In the majority of cases it is remarkably uniform. He is convinced that a division of cases of pyloric stenosis of infants into spasmodic and hypertrophic types is not admissible. In hypertrophic stenosis the pylorus forms a tumor which is about as large as a peanut or the last phalanx of the little finger. It is of a glistening white color and has a

¹⁵ American Journal of Diseases of Children, September, 1917.

¹⁶ Archives of Pediatrics, July, 1917.

cartilaginous hardness. The opening into the duodenum may be so small as to admit only the finest probe. In some cases even water cannot be forced through, but usually the normal opening is only much narrowed. On longitudinal section the hypertrophy is seen to involve not only the pyloric ring but the entire antrum, which may be two or three times its normal thickness. It has a pearly white color and seems to be almost destitute of bloodvessels. In recent cases there is usually a considerable amount of edema. Microscopically the longitudinal layer and the submucous and the mucous coats are in most cases quite normal. The lesion is practically limited to the muscular layer. The circular fibers are much increased, both in size and number. There is a true hypertrophy. The walls of the stomach are often found somewhat thickened and its cavity is generally dilated. The intestines are frequently empty and collapsed. There are no other lesions of importance.

The clinical picture presented by a case of hypertrophic stenosis is a striking one, and, in a large majority of those seen, it is remarkably uniform. An infant, usually breast fed, who has nursed well, gained normally in weight, has had sufficient and well-digested stools, and has, in fact, shown few or no other signs of disturbance and begins to vomit persistently and forcibly. These symptoms have their most frequent beginning in the third or fourth week of life, and in most cases their onset is abrupt and without assignable cause. To the forcible vomiting are added marked constipation, steady loss in weight, and all the symptoms belonging to failing nutrition. Careful examination reveals definite gastric peristaltic waves, and, in most cases, a palpable tumor in the pyloric region. While a palpable tumor cannot be considered essential to the diagnosis, it will usually be found by a careful observer under favorable conditions.

Abnormal gastric retention is easily estimated by emptying the stomach two, three or four hours after a test meal by means of a simple suction apparatus composed of a rubber catheter, a small laboratory wash bottle and a suction tube. The test meal employed is 2 or 3 ounces of breast milk. Diluted breast milk answers the purpose, but one should not employ mixtures of unboiled cow's milk, as the coagulated milk in the stomach may block the tube.

The *diagnosis* of hypertrophic stenosis in most instances is easy, provided one is familiar with the disease, for the symptoms in fully four-fifths of the cases are classical. In some, especially of the milder forms, several days of close observation may be necessary. Enumerated in order of their diagnostic importance, Holt places the points in the following order: (1) The history, if obtained from a reliable mother or nurse; (2) abnormal gastric retention, observations being repeated three or four times at least; (3) peristaltic waves, not of diagnostic value unless typical; (4) the presence of a palpable tumor; (5) wasting, constipation, scanty urine, etc. It is doubtful whether the *x-rays* tell more than can be learned from careful observations of the gastric retention as described above. Furthermore, it must be remembered that these patients are very young, most of them in very bad

condition and that they bear the manipulation incident to successive investigation with the bismuth meal very badly.

The *medical treatment* of hypertrophic stenosis consists in careful feeding and stomach washing. The gastric lavage should be practised at first twice a day, later at longer intervals; it serves the purpose of emptying the stomach thoroughly of mucus and fermented food; the water used should be warmer than usual, that is, up to 112° F. If it can be secured, breast milk is the preferable food, but one not rich in fat is desirable. The common practice of weaning as soon as symptoms develop is most unwise. In default of breast milk a modified milk mixture low in fat should be used.

After an extended consideration of the medical and surgical treatment, Holt concludes that hypertrophic stenosis of the pylorus in infancy is a pathological entity. It should not be confused with other pathological conditions which may be accompanied by vomiting and occasional gastric peristalsis. Many of the milder forms recover with only medical treatment. All those which do not recover under such treatment in the course of two or three weeks, and the more severe types in a much shorter time, should be treated surgically. The symptoms which indicate surgical intervention are rapid loss of weight, persistent vomiting and forcible, gastric peristalsis. The presence of a palpable tumor and abnormal gastric retention aid much in diagnosis. The *x*-rays reveal nothing of importance which cannot be discovered by a study of gastric retention and without its dangers.

The cases which come under observation after four or five weeks of vomiting and marked loss in weight are best treated by operation as soon as the diagnosis is established. The earlier operations of gastro-enterostomy, divulsion, pyloroplasty, etc., were unduly severe and prolonged; they should be abandoned for the simple external division of the circular muscular fibers proposed by Rammstedt. Results by the same operator, on the same class of cases in the same institution and with the same treatment, show the great superiority of the Rammstedt operation to gastro-enterostomy and to medical treatment. Cases of gastro-enterostomy followed for four to eleven years indicate that growth and development are not impaired by the operation. Cases followed two and three years after the Rammstedt operation show no interference with health and progress. Cases not operated upon usually show no symptoms after the first year. Yet the possibility that this condition may be the basis of pyloric obstruction in later life undoubtedly exists.

The diagnosis of pyloric stenosis and pyloric spasm by the duodenal catheter is described in detail by Howell,¹⁷ of Boston. He believes that this offers the easiest and most reliable means of detecting pyloric obstruction in doubtful cases.

Pica. The habit of dirt-eating,¹⁸ called pica, occurs as a neurosis in children between the first and second years, and sometimes in older persons, as a form of perverted appetite. In most of these cases,

¹⁷ Archives of Pediatrics, March, 1917.

¹⁸ Journal of American Medical Association, April 11, 1917.

earth, cinders, etc., may be consumed with avidity, whereas ordinary food is refused. Such patients become thin, sallow and unhealthy looking and suffer from colic and diarrhea. The condition is usually curable by prevention, by producing free evacuation and by supplying plenty of wholesome food. In case the habit is associated with mental deficiency the treatment is directed toward that condition. The condition is psychological in character and must be treated from a physiological point of view.

Intestinal Infantilism. A case of this character is reported by Holt¹⁹ in which the use of cod-liver oil apparently resulted in decided improvement. He states that the subject of these observations was a girl, aged eight and a half years, who was suffering from infantilism, apparently due to chronic intestinal indigestion. Metabolism observations were made at the beginning and at the end of a period during which cod-liver oil was administered. The metabolism at the beginning of the period showed negative balances in calcium, magnesia, phosphorus and total ash. At the age of eight and a half years the child's net weight was twenty-seven and a half pounds and her height was thirty-nine inches. In nine months she gained, under the administration of cod-liver oil, two and a half inches in height and thirteen and a half pounds in weight. At the end of the period, metabolism observations showed a marked positive balance in calcium, magnesia and total ash. It was quite possible that the malt used with the cod-liver oil might have had something to do with the gain. Holt states that he had confirmed the finding that in rachitic cases with the administration of calcium salts there was an increase of from 25 to 40 per cent. in the amount of calcium retained. He had thus demonstrated the value of calcium in rachitis. In regard to the negative balance the child could not have had a negative balance all the time. There had been, however, no gain in weight for four years previous to the administration of the cod-liver oil. Just how much of the gain was due to the cod-liver oil it was hard to tell, because simply an increase in the intake of salts would cause a retention. He concluded, however, that the cod-liver oil was a large factor in the gain.

In discussing the subject, Talbot,²⁰ of Boston, said that there were two points of interest in this case. One was that the negative balance could not have been present all of the time, though it was probably present more than it was absent. The second point was that even with the cod-liver oil the absorption of available nutrition was only 66.67 per cent., whereas under normal conditions it was 90 per cent. Hermann,²¹ of New York, said that this case well illustrated the point that gain in weight and increase in height do not necessarily go hand-in-hand. Hoobler,²² of Detroit, said that the child was also fed malt, and that possibly might have had something to do with the gain.

Chorea. Among the apparent real advances made in recent years is the AUTOSERUM TREATMENT of chorea. One of the most authoritative articles on the subject is that of Moffett,²³ of New York, who gives a brief

¹⁹ Medical Record, September 8, 1917.

²² Ibid.

²⁰ Ibid.

²³ Ibid.

²¹ Ibid.

description of the disease from the historical and etiological stand-point. Chorea was the name originally given to the cases of dancing mania which occurred along the Rhine, at the beginning of the fifteenth century. These cases of real chorea were followed by cases of pseudochorea which were in the persons of children or others who imitated the real cases. This became so extensive as to warrant being called an epidemic. Such epidemics have also occurred in Italy and France. In our own country, in 1803, such an epidemic occurred in Tennessee, and was well described by Douglas Robinson in 1825. Real chorea must be differentiated from the ordinary types of habit spasm, such as twitching of one eye which is so common in children.

Chorea is a nervous disease which is usually characterized by involuntary movements of the muscles of the face, hands, and arms. It is accompanied by great muscular weakness and prostration. Not infrequently it follows attacks of rheumatism and tonsillitis, and is usually accompanied by endocarditis. A true chorea, usually accompanied by what is called chorea minor, was first described by Sydenham in 1686, and his description is so classical that it cannot be improved upon to this day.

It is most common among females. The proportion is three to one, and it is most common between the fifth and eleventh year, usually coming on at the end of the first half of the school year. We rarely see this condition in the summer months, so that worry, exposure to cold, dampness, and infection of the nose and throat and of the respiratory organs, seem to be the forerunners of this condition.

We have almost reached a point, with our newer ideas upon this subject, where we almost feel that chorea is an infection of the nervous system, the infection being similar to that which is caused by so-called rheumatic joints, the exact organism of which we have been unable to isolate. The disease acts like an infection and responds like an infection. Numerous examinations of the spinal fluid of cases of chorea by the newer laboratory methods of Rosenow have failed to show the exact cause present. As far back as 1850, Germain Sée stated that chorea was due to rheumatic infection of the brain and spinal cord. That the poison is a microbe is suggested by the frequent unilateral character of the disease. It is almost invariably more marked on one side than on the other. This, according to Cautley, indicates a local cerebral lesion rather than a general cerebral toxemia. It is probable that more than one organism can give rise to chorea, for attacks follow many infectious diseases.

Probably functional instability of the nervous centers is a potent cause and may depend upon malnutrition. The morbid anatomy of cases dying of chorea is that of any case dying from extreme emaciation. Endocarditis has been noted in 105 out of 115 autopsies collected by Osler. Sturgis found organic heart disease in 75 out of 80 fatal cases. Usually the mitral valve is affected, but sometimes the other valves may be involved. The muscle of the heart usually has undergone fatty degeneration, and not infrequently a small amount of inflammatory exudation may be seen between the muscle fibers. Reichard, in 192, found changes in the nervous system which he believed due to a general toxemia, such as degeneration of the anterior and posterior root fibers

in the cord and small-celled infiltration throughout the brain; also small hemorrhages in the neighborhood of the basal ganglia. Neuwerck has mentioned these hemorrhages also. No observer has been able to demonstrate any abnormality in the cortex of the brain.

Leopold and Bernhard²⁴ made twenty-one careful chemical examinations of the spinal fluid of children with chorea and the figures obtained for non-protein nitrogenous constituents and for reducing substances showed no variations from the normal. The number of cells counted was normal except in 4 cases, and the globulin reaction was negative in every case. No child with chorea has given a positive Wassermann reaction, which, in a series of 21 cases, would indicate that syphilis plays no role in this disease.

About three years ago Dr. A. L. Goodman, of the German Hospital of New York, suggested the use of autoserum in the treatment of chorea. This treatment, known as the Goodman autoserum treatment, consists in taking of the blood from the arm of a patient suffering from chorea, separating the serum from the blood and then injecting the serum into the spinal canal of the same child after withdrawing 15 to 20 c.c. of the spinal fluid. Since this treatment was first suggested there have been about 100 cases of chorea minor treated in this manner, with very remarkable results in some of the cases.

At first the simple withdrawing of the spinal fluid was tried out, but no appreciable change in the movements of the arms, face or legs was noted. This simple withdrawing of the fluid was followed up by the injection of the serum of the child thus affected. The patient should be kept in bed without medicine of any kind, such as chloral, bromide or arsenic, for four or five days before any treatment is instituted. In one case a patient was injected during the time it was under chloral and bromide medication, which almost proved disastrous. The patient went into a coma which lasted for four or five days. Another important precaution is to ascertain if the child has tuberculosis or syphilis, as these cases do not do well if injected. Children with enlarged thyroid do not do well if injected with autoserum, but improve when treated with extract of the thyroid gland.

Fifty cubic centimeters of blood are withdrawn from one of the veins in the arm and then rapidly centrifugalized, which separates the serum from the blood. The serum is then pipetted into a sterilized vessel and placed in the incubator and kept at the temperature of the body. A lumbar puncture is performed in the usual manner and 20 c.c. of the spinal fluid is allowed to flow out. In cases of chorea this is usually under a little pressure. After 20 c.c. of the spinal fluid has been withdrawn, the blood serum at the body temperature is slowly injected. This usually takes from five to eight minutes and the patient is kept in a recumbent position in bed for at least one or two hours after injection, for if allowed to sit up immediately after injection, heart collapse sometimes follows. If the serum injection is to be of any benefit in a case of chorea, improvement should be noted in two or three days. The first injection is followed

²⁴ American Journal of Diseases of Children, June, 1917.

in five or six days by a second one, which is performed in the same manner. There are one or two things which develop the day following the injection which should be noted, but which, at the same time, are not serious symptoms. A slight rise in temperature, vomiting, an increase in the pulse rate and in some cases a slight stiffness of the neck. These all disappear within a few hours. Some of the patients have had a slight amount of frontal headache. However, these symptoms do not all appear in every case. It is probably due to a slight increase in the cranial pressure.

Of the cases treated, 5 per cent. have had a recurrence within a year. This is considerably lower than under the usual form of treatment.

Treatment of Chronic Intestinal Indigestion in Children. In writing of the treatment of this condition in children, Rewalt²⁵ asserts that it is of extreme importance to keep the child in bed if there is any elevation of temperature. The patient should remain in bed for three or four days after the temperature has reached normal and should be allowed to be up gradually. A nap of two hours daily, proper food and proper exercise are of great value. The diet should consist mainly of scraped beef, beef juice and milk. If the child improves, orange juice may be added after two weeks. Then oatmeal or barley gruel may be added to the milk and later stale bread and toast may be allowed. These articles of food, to which a soft-boiled egg, animal broths and the white meat of chicken may be added later, should constitute the diet for six months. The stools should be closely watched. If there is much mucus, intestinal irrigation is called for. Warm saline is the best irrigating fluid. For the constipation, calomel and phenolphthalein, 0.1 grain each, every half-hour for ten doses, are advised.

BREAST FEEDING.—For years pediatric practitioners have endeavored to teach the important principle that mothers may be able to nurse their babies if persistent and rational effort be made on the part of the physician. An excellent article is presented by Sedgwick,²⁶ of Minneapolis, upon the establishment, maintenance, and restitution of breast feeding. He refers particularly to premature and very weak infants who are not capable of securing enough nourishment from the breast by their own effort. Such children may often be kept alive by feeding breast milk expressed by the hands. The inability to secure milk in this way is often due to faulty methods of expression. Sedgwick advises the following method: The breast is grasped 1 or 2 cm. back of the colored areola, and a milking motion is carried out toward the nipples. Nurses and mothers soon gain a manual dexterity which is surprising. No massage of the breast is allowed, as it is of little, if any, value, and, sometimes causes traumatic inflammatory reaction. If we consider the anatomy of the breast, we learn that the ducts which contain the milk extend but a short distance back of the areola. Anyone who ever saw a cow knows that the teats are milked and not the cow's bag, and yet we often find head nurses, physicians, and even pediatricians giving instructions to milk or massage the

²⁵ Pennsylvania Medical Journal, May, 1917.

²⁶ Journal of American Medical Association, August 11, 1917.

breast gland itself. If this method is intelligently followed, it is possible to keep the mother of the premature child from losing her milk.

The technic of *wet-nurse management* in institutions is the subject of an exhaustive paper by Abt,²⁷ of Chicago. It is a paper of great interest, but it is not of the type to be profitably condensed into a small space.

The *collection and distribution of mothers' milk* has been carried out with great success in the Woman's Hospital of Detroit. The methods employed are described by Raymond Hoobler.²⁸ He asserts that in six months' time, 23,000 ounces of mother's milk were collected and distributed. It is important to have the milking of the breasts done under the supervision of a trained nurse. The hospital admits to its service, in addition to a large number of private patients, a number of young, unmarried, pregnant women who for a small fee are delivered and cared for during a period of three months following delivery. These girls are taught to take care of their own babies, and, in addition, perform light service about the home. It is the aim that every mother shall nurse her own baby. If she has more than sufficient milk, it is expressed and fed to the babies who do not have sufficient. From among these mothers many are found who produce much more than is necessary for their babies and this forms the basis of an excess quantity of human milk which is available for use outside of the hospital. All mothers are carefully tested as to their physical condition; Wassermann reactions are taken; and all expressing of breasts is done under the eye of a trained nurse who teaches the mother the technic of expression. The milk is collected in sterile bottles, measured, credited to the account of the mother and then put in a refrigerator. During the period of stay in the hospital, the mother accumulates a neat sum to help her when she must go out into the world with two to support, and at the same time has been taught the value of her breast product and has lost the hesitancy of supplying it for other babies.

Through the active manipulation of the breasts, done, as a rule, every four hours, the breasts secrete an increasing amount of milk; and at the end of a three-month period, if the mother has developed a good milk-producing capacity, that is from 16 to 24 ounces above the amount necessary for her own baby, she is urged to continue in the hospital as a producing mother; or if she has suitable home surroundings in the city, she is urged to continue milk production as a means of earning her living, in which case she returns to the hospital two or three times daily for the purpose of expressing her milk. In this way many mothers are able to support themselves and their babies until such time as they regain confidence, or their homes are again thoroughly established.

Other nursing mothers not connected with the hospital are appealed to by advertisement in the daily press and by placards in dispensaries, in several languages, stating that mothers who have an excess of milk may find remunerative employment, while remaining at home, by applying at the distributing center. The mothers are visited in their

²⁷ Journal of American Medical Association, August 11, 1917.

²⁸ Ibid.

homes; and if the homes are found suitable, and their physical examination and Wassermann test are negative, they are placed on the list as contributing mothers. They come to the hospital twice daily and have their breasts expressed; the milk supply is well maintained by two expressions, particularly if the breasts are suckled between times. The babies of the mothers are weighed and examined regularly.

A diet of a nursing mother, to be efficient must produce a sufficient quantity of milk, containing nutrition adequate to cause an increase in growth of offspring without impairing the tissues of the mother. Diets containing from 2600 to 2900 calories in twenty-four hours produced better results than diets containing from 3400 to 3700 calories. It is of no avail to overfeed in the hope of maintaining or increasing the milk supply. Diets containing 2000 calories, or less, cannot protect maternal tissues and at the same time produce sufficient milk. A nutritive ration of less than 1 to 6 gives best results. Animal protein is better than vegetable protein for purposes of milk production. Nut protein is as efficient as animal protein in elaboration of milk. The best form of animal protein to protect maternal tissues and increase milk production is cow's milk protein. In studying the effect on human milk production of diets containing various forms and quantities of protein, Hoobler says that knowledge of the proper diet for nursing mothers whose milk supply is not sufficient or is failing, is inadequate. He has attempted to determine the effect of diets containing various amounts and kinds of protein on the production of human milk. What is the minimum amount of protein that should be fed to protect maternal tissues, that is, what nutritive ratio should exist between the protein on the one hand and the carbohydrate and fat on the other? Is there any difference between the animal protein and vegetable in their effect on milk production? If so, which is best? Is one kind of animal protein better than another to protect the maternal tissues? In this investigation some twelve different diets were tested. The results obtained from a purely vegetable diet suggest the futility of excluding from the diet at least a certain amount of animal protein. Many mothers are trained during the latter part of their pregnancy to eliminate albuminous food from their dietary because of albuminuria. The fear that albuminuria may persist causes these women to continue a low protein diet which is frequently a cause of failing milk supply.

In summarizing his studies, Hoobler concludes that a nutritive ration of 1 to 6 seems best adapted to the needs of nursing mothers. This ratio refers to the proportion of digestible protein to digestible fat and carbohydrate, the latter reduced to a carbohydrate basis. Animal protein is more suitable than vegetable protein in supplying nitrogen for milk and maintenance of the nitrogen balance. The protein, when derived from nuts and when fed with other vegetable protein is suitable for supplying milk protein and maintaining nitrogen balance. A diet composed exclusively of fruits, nuts, and vegetables does not supply sufficient protein for elaborating milk protein and causes a severe drain on the tissues of the mother. Of the various forms of animal protein, that derived from cow's milk seems particu-

larly suitable for the production of human milk protein as well as for the preservation of the maternal tissues. It is found that a diet which just maintains the nitrogen equilibrium is in many respects preferable to one which tends to add weight.

Infant Feeding. The number of articles on infant feeding has been considerable during the past year, but far less than the average. There seems to be a tendency to increase the interval of feeding. A tendency to eliminate night feeding entirely has constantly grown during recent years. One of the best reviews of the essentials of infant feeding is that of Freeman,²⁹ of New York. He starts with the obvious proposition that successful feeding depends upon giving the baby a food that it can digest and from which it can obtain nourishment in proper amounts at correct intervals. He believes that no baby a month old should be fed more often than every three hours (six feedings a day), and after six months no more often than every four hours (five feedings a day). Feeding between 10 P.M. and 8 A.M. should be eliminated during the first month.

The amount of food that should be given to a baby depends upon its size, age, activity, and appetite. In general terms, a child of one month will take from 2 to 3 ounces of milk; at two months from 3 to 4 ounces; for each successive month, 1 ounce more than the number of its age; during the balance of the year it will take less than the number of its age and at twelve months not more than 10 ounces. The amount of food may usually be increased about $\frac{1}{2}$ ounce every two weeks during the first eight months.

The best indication of success in infant feeding is the rate of gain in weight. Balance, not spring, scales should be used. A platform scoop scale sufficiently accurate may be purchased for \$3.50. A baby should gain about 5 pounds during the first three months; $3\frac{1}{2}$ pounds during the second three months; 3 pounds during the third three months; $2\frac{1}{2}$ pounds during the fourth three months, beginning with a weight of about 7 pounds and having a weight of about 21 pounds at the end of the first year.

The breast milk of a baby's mother is so superior to any other food in the early months that it should be guarded by allowing the mother little work and ample diet, with plenty of water, until the baby is several months old. Babies should be nursed, if they do well on breast milk, for six or eight months. If the baby does not do well on breast milk do not wean it, but ascertain how much it is getting by weighing before and after feeding, the difference in weight being the amount of food taken. Also obtain, by expressing the breasts or by a breast-pump, a sample of the milk sufficiently large to get the specific gravity and make a Babcock test. If the milk is deficient in amount, stimulate the breasts by nursing both breasts every three hours and giving the mother a thick malt extract; while if it is deficient in quality, add a bottle after each nursing that will supply what is deficient in the breast milk. Never reduce the number of nursings because the breast

²⁹ Bulletin, New York State Department of Health, June, 1917.

milk is deficient, for the less you use the breasts the less milk they will produce.

Modified cows' milk is, for general purposes, the most satisfactory substitute for breast milk. By modified milk we mean diluted milk to which sugar is added. For normal babies at birth, 1 part milk to 3 parts of diluent is usually well taken; while at one month, 1 part milk to 2 parts diluent can usually be taken; and at three months equal parts milk and diluent, the proportion of milk being then gradually increased until undiluted milk is given at ten or twelve months. Sweet orange juice should be fed at 9 A.M. After the sixth month, beginning with a teaspoonful and gradually increasing to the juice of one orange.

The milk used should, if possible, be certified milk pasteurized in the nursing bottle at 145° F. for thirty minutes or 140° for forty minutes. It may be simple mixed milk or top milk. Mixed milks are usually preferred for marasmic or sick children, while for healthy children a moderate amount of cream may be added to bring the total fat up to 3 per cent. The diluent may be water, but a cereal diluent is usually more digestible. This is generally a barley or oatmeal flour, 1 even teaspoonful to 1 pint of water, cooked for one hour in a double boiler and strained. The added sugar, which should usually be 4 or 5 per cent. of the day's feeding, is ordinarily lactose, the normal sugar of milk, but, if the child does not gain on this, a preparation of maltose may be used. In feeding babies of the very poor, saccharose may be used in the same proportion for the sake of economy. Babies who are not gaining or who are having curds in the stools will often do better if the milk is temporarily peptonized. An excellent food for young babies who do not thrive on modified milk is whey, to which cream and sugar have been added.

At ten months 2 ounces of clear soup, with no fat on the top, may be added, and rusk or bread crust or toast, with three meals a day. When a baby becomes sick, give a large dose of castor oil, 1 teaspoonful to a baby under six months, 1 dessertspoonful to a baby under a year, and 1 tablespoonful to one over a year, and for a day or two withdraw the milk from the food. The other elements can usually be continued. For diarrhea, there is no better remedy than 2 drops of castor oil after each feeding, following a large initial dose, this being used in addition to colon irrigations, followed by an injection of a starch solution. An excellent food in cases of persistent diarrhea is proteid milk. This is prepared by taking 1 quart of milk, warming it, adding rennet and keeping it warm until the curd separates from the whey. It is then put in a cheesecloth bag and, without pressure, the whey is allowed to drip away from the curd. This removes much of the sugar and salts of the milk. The curd is then broken up by passing several times through a strainer and mixed with 1 pint of water and 1 pint of lactobacillary milk. This food is fed uncooked, and is one of the best foods in this condition. In the care of babies, always know the character and the formula of the food you are using, whether breast or modified milk. Never increase the food if the baby is gaining, unless it seems very hungry. In very hot weather reduce somewhat the quantity of food.

Another admirable review of the subject has been presented by Reuben,³⁰ of New York. It is based upon six years of experience as physician in charge of the infant-feeding station connected with the College of Physicians and Surgeons of New York. It enters into extensive details and describes wide experience in the feeding of children of the dispensary class.

THE INFLUENCE OF OATMEAL GRUEL IN THE FEEDING OF INFANTS is considered by Levinson,³¹ of Chicago. Oats (*Rispen Hafer*, *Avena Sativa*) has from time immemorial served as a food for human beings. The oats used for animals is that of *Avena Orientalis*. In some countries the peasant classes have, in times of stress, been known to live almost exclusively upon this grain. Every land has a species peculiar to its soil and climate, but the food value of the grain is much the same everywhere. Oats contain a higher percentage of carbohydrates and fat than other grains. The fat in oats, being higher in percentage, is better in quality than that contained in other grains. Töpfer found that the fat of oats has 11.49 per cent. lecthin (0.44 phosphorus) the amount differing with the species. The iron content of oats is also very high. The French innovated the use of oats in infant feeding, and its efficiency won for it many advocates. Now oats is being used quite extensively for well and sick children in the form of oatmeal gruel and breakfast foods. The writer presents the results of work with one preparation made from oats—oatmeal gruel. His article contains numerous tables, and a mass of statistics, from which he concludes that oats is an important addition to infant food; the most valuable preparation is oatmeal gruel; the 5 per cent. solution is the most efficacious; oatmeal gruel may be prepared very simply by washing grits in cold water and boiling thirty minutes and straining. Gruel can be given at any age, with beneficial results; it increases the appetite of the child; it makes the stool homogeneous; it often relieves constipation; it has a high iron content; the gruel prepared in the above way contains 15.671 grams of dry substance in 1000 grams; the caloric value of 1000 grams is 54 large calories.

The subject of BOILED MILK has received much consideration during the last two or three years. An interesting review of the subject is presented in an editorial,³² which refers to studies made by Brenne-mann, to which reference was made in these pages³³ last year. The obvious menace from microorganisms which attends the use of raw milk led to the introduction of some mode of heating to avert the dangers of bacterial infection which even rigorous inspection cannot always discover. Heating milk to 60° C. (140° F.) and holding it at that temperature from twenty to thirty minutes will destroy the viruses of tuberculosis, typhoid fever, scarlet fever, diphtheria, Malta fever, dysentery and foot-and-mouth disease. It will also destroy streptococci, staphylococci and practically all the non-spore-bearing micro-

³⁰ Medical Record, August 4, 1917.

³¹ Archives of Pediatrics, September, 1917.

³² Journal of American Medical Association, December 2, 1916.

³³ PROGRESSIVE MEDICINE, March, 1917, p. 224.

organisms pathological for man. To provide a factor for safety, a somewhat higher temperature and longer period of heating are often adopted in the usual routine of pasteurizing milk. The products treated in this way do not exhibit any appreciable alteration in taste or digestibility.

The actual boiling of milk or heating to the temperature of boiling water is even more effective as a means of sterilization, and was early employed. Boiled milk has been used widely, particularly in certain European countries, to replace raw milk in infant feeding. In America a widespread prejudice has arisen against it. We are told that the more vigorous heating affects decomposition in the product; the proteins are somewhat altered; the sugar is liable to become slightly oxidized; the normal emulsion of the fat globules is changed; the digestibility varies from that of raw milk. Boiled milk has been charged with being exceptionally constipating to infants. For these and related reasons there has been a tendency to prefer prolonged pasteurization at lower temperatures to the simpler expedient of boiling.

More recently, both boiled and pasteurized milks have been assailed as undesirable, in that certain ill-defined biological properties are lost by the heating processes. Most specific is the charge that the prolonged exclusive use of even pasteurized milk leads to the manifestation of scurvy. This disease in children can readily be averted by the use of orange juice and other antiscorbutics. Accordingly, in debating the value of pasteurization, it has become necessary to balance the acquired safety from bacterial infection against the alleged loss of the antiscorbutic virtues of raw milk. As an outcome of all this, the most varied contentions are put forth. One group of enthusiasts insists on the ideal of a pure, clean milk supply, certified so as to do away with a need of safeguards in the nature of heat; another demands pasteurization as an indispensable adjunct to inspection; and now we are asked to consider anew the advantages of boiled milk.

The foremost objection so far raised to heated milk concerns the alleged appearance of scurvy which attends its use. The recent enthusiasm for the vitamin doctrine has made it easy to ascribe harm to the destructive action of heat on some as yet unidentified vitamin in milk. Not all vitamins appear to be so sensitive to heat, however. Even a superficial study of the literature on scorbutus serves to awaken an apprehension of the paucity of dependable knowledge on the subject.

The guinea-pig has served as the classic experimental animal for the investigation of scurvy. By extremely one-sided diets of certain grains, Holst and his co-workers were able to produce the typical symptoms and to prevent them by the use of certain antiscorbutics. Some of the subsequent attempts to apply this method to the solution of the milk problem has been disappointing. How unjustifiable certain conclusions based on the guinea-pig experiments may be is indicated by the recent studies of Jackson and Moore. Experimental scurvy was produced by them in guinea-pigs on diets of pasteurized, raw, skimmed, and condensed milk and many other dietary combinations. The onset of the symptoms with these milk diets of various kinds was

quite early. They were even produced by feeding whole milk, oats and hay water.

Pasteurization has many almost insurmountable technical difficulties. Boiled milk has obvious bacteriological advantages in the established freedom from dangerous microorganisms. According to Brennemann, the heating which it demands does not impair the nutritive properties in comparison with milk merely heated to pasteurization temperatures. There is occasion here to exhibit the "open mind."

The subjects of CONDENSED MILK and DESICCATED MILK in infant-feeding is intelligently discussed by Marfan.³⁴ He insists that condensed milk should never be allowed as a regular diet but that both condensed and desiccated milk are valuable in emergency to supplement the regular diet for a short time or transiently during the heated term when good, fresh milk cannot be obtained. He thinks that condensed skimmed and sweetened milk keeps better than when made from whole milk, and that it is digested more readily by the infant, especially when it has digestive disturbances. When good, fresh milk cannot be obtained, desiccated milk may be used for the regular food. Many physicians have reported good results with it, and Marfan's trials have been encouraging with milk powder made with half its fat. It is useful when the infant's condition calls for concentrated food of small volume with little liquid or when a food poor in fat is required or food in which the albuminoid substances have been modified in a way to promote digestion. Desiccated milk might also be given a trial with habitual vomiting in infants who cannot get breast milk.

Marfan believes with the ordinary diarrhea of bottle-fed babies nothing is so good as BUTTERMILK. Up to the age of three or four months this is preferable. Above this age malted soups are better, made first with water alone and then with increasing amounts of milk. Sometimes the buttermilk and the soups do well together. But when buttermilk cannot be obtained, desiccated milk is the next choice. With choleriform diarrhea, desiccated skimmed milk has given him as good results as buttermilk. When an infant displays actual intolerance for cows' milk, condensed milk, desiccated milk or buttermilk may be indicated. By giving the milk powder at first in small amounts, rapidly increasing the amounts, an antianaphylaxis may be developed. When an infant is not growing properly, it may be well to try different foods, changing from desiccated to condensed milk or buttermilk, leading up to a return to fresh, boiled milk. For infants with athrepsia, breast milk is the only salvation, but it usually comes too late. In conclusion, Marfan adds that condensed and desiccated milk may be found useful at any age with a tendency to dropsy. They form a good, concentrated food when fluids have to be restricted.

TENDENCY TO FAT INCAPACITY IN INFANCY AND CHILDHOOD. This tendency has been studied by Southworth,³⁵ of New York. He refers to the fact that has been observed by all practitioners of experience

³⁴ *Le Nourrisson*, Paris, v, No. 1, pp. 1 to 64; *Journal of American Medical Association*, June 2, 1917.

³⁵ *Journal of American Medical Association*, August 18, 1917.

with children, that there is, in a certain number of babies, an inability to digest the dietetic amounts of the fat of cows' milk. Many physicians can recall the day when excessive amounts of fat were given, and when bad symptoms resulted they were attributed to other elements. When later the real factor was recognized, the reduction of excessive fat and the use of mixtures made from whole milk, though often remedial, did not in all cases serve to eliminate the difficulty. The next logical step was to employ milk, more or less skimmed, in feeding infants whose digestive capacity had been seriously disturbed. The pendulum swung for a time too far in this direction, owing to a failure to recognize still other factors which entered into the feeding problem. Nevertheless a certain number of babies may still be found who do not tolerate the fat of cow's milk well. It is not always a temporary incapacity, which may be overcome by careful feeding, but is, in some instances, an inherent characteristic which must be recognized if the best results for the individual are to be attained in later infancy and childhood.

Our knowledge of this matter has been of slow growth, certain obvious analogies in somewhat later life having been apparently overlooked. Long before the days of modern infant feeding it was currently accepted that certain adults could not take cow's milk in any quantity without suffering, as they asserted, from constipation and "biliousness." Even before the recognition of fat constipation in infancy and childhood, it was known that some of these adults could take skimmed milk or fat-free buttermilk without producing these symptoms. Of late years pediatricians, in increasing numbers, have found that older children suffering from nutritional disturbances of rather vague origin, but more definite symptomatology, were not only not benefited when they were given more of a supposedly digestible milk, but were greatly improved when the quantity of milk was reduced, when it was skimmed or, in some cases, when it was drawn entirely from the dietary. In some instances this has apparently been done because of a suspected analogy to the fat incapacity of infancy, but more commonly on the ground that milk did not agree with them.

Some who have so treated their older children must have been aware from the histories in their hands or from careful inquiry, that these children had suffered at some time in their infancy from fat injuries or from fat incapacity, but no deductions have been drawn from literature from this significant relation.

If not a few older children are found who do better with little or no milk and whose histories reveal that they suffered in infancy from disturbances evidently due to the fat of cows' milk, is it not a justifiable deduction that a certain number of infants who have shown a fat incapacity cannot wisely be given much whole cows' milk as they grow into childhood? It is a mistake to aim at getting such children back to a full-fat milk, but more general success is to be attained by continuing to feed partially skimmed milk and to limit its amount in order that the sum total of fat, even in such skimmed milk, should not exceed their capacity. The latter precaution is not irrational, for we have some precedents. We recall that although this country passed through a period of high

fat feeding for infants we did not originate the term *Fettnahrshädigung*. This came from German sources, and the Germans habitually use dilutions of whole milk in infant feeding and not our superfatted mixtures. There the only explanation of the fat injury lay in the fact that even diluted whole milk, if given in the strong mixtures commonly used abroad, could carry with it sufficient fat to overtax the infant's capacity. This overtaxing may have occurred more frequently because disturbances of digestion are complex in their origin, the more evident fat indigestion being aggravated by similar, if less evident, difficulty arising from overfeeding with other elements of milk.

If the plan of adhering to skimmed milk were followed in more cases of limited fat capacity, the progress of such children would be more normal, and the skimmed milk, which in itself is a valuable food, could be retained in the dietary. Also, it would less frequently be necessary to eliminate milk altogether from the dietary of older children because of long-standing, subacute digestive disorders.

Associated with such disorders we often find a characteristic loss of appetite and a small range of diet, many ordinary wholesome articles of food being refused whimsically, probably because the children have been cloyed with their milk fat. Often also they have been allowed butter very freely, owing to a desire to improve their nutrition. This hydrocarbon satiety and disturbance is doubtless comparable to the carbohydrate satiety found in children who have been allowed an excess of sucrose.

The same disturbing element may at times be recognized in children not especially disposed to such disturbance who habitually drink excessive quantities of milk daily or a considerable amount of high-fat milk from fancy blooded herds of Jersey, Alderney or Guernsey cows. In such cases a reduction of the milk taken, or the removal of part of the cream, may be all that is essential to bring about improvement.

It is inevitable that in caring for successive children born into the same families that the digestive difficulties and peculiarities of the older children should be recalled when taking care of a new scion of the house. When, however, an infant born before the days of the recognition of limited fat tolerance had been difficult to feed, and a second infant, born about the time of our realization of the import of such limitation had been rescued from similar difficulties by our application of this knowledge, what could be more natural than that, with the advent of the third baby, similar tendencies, when manifested, should be met at the outset by appropriate measures and much better results obtained?

FEEDING OF OLDER CHILDREN. A recent survey of the leaflets of advice on dietetics and food economies disclosed the fact that much was being said about feeding babies and adults, but that little was being said regarding that very important group in the community, namely, children from two to seven years of age. At the request of the New York City Department of Health a leaflet has been prepared to meet this need. It represents a large amount of careful work by four members of the Health Department's Advisory Council, namely, Drs. L. Emmett Holt, Graham Lusk, Linnaeus E. LaFetra and Godfrey R. Pisek, and

constituted an authoritative statement. The computation of food prices was made by Dr. F. C. Gephart. The leaflet is designed especially for the use of visiting nurses, social service workers and others who come into close contact with those who are most in need of instruction in food economies. Copies of the leaflet may be obtained on application to the Bureau of Public Health Education, Department of Health, 139 Centre Street, New York.

The food requirement of healthy children is the subject of editorial³⁶ comment which calls attention to the fact that so much study has been devoted to problems of nutrition and energy transformations of the adult body that the requirements as expressed in units of food fuel are beginning to be better understood both by the profession which has to deal with them and by the laity. It would be an exaggeration to say that many persons are qualified to speak of daily food in terms of calories as they discuss gallons of gasoline or tons of coal in connection with other affairs of daily life. But there are signs of a more tolerant attitude toward the new language in which human dietary needs are best expressed. The exigencies of the present moment have served to focus attention more firmly than ever on what the nutritive needs of the living body really involve.

For the long period of childhood and adolescence the available information is still far from adequate, and what is known has not yet become as readily accessible as it ought to be. A few years ago it was customary, in calculating dietary needs, to figure the portion belonging to the children of the family in terms of some roughly fixed fraction of the daily allowance for grown-ups. There is, however, an enormous range of variation in the food needs of children occasioned by the unlike physiological status of these individuals at different ages and stages of growth. Age, size and activity occasion distinctive demands which have come into bolder prominence since the relief of enormous numbers of children of all descriptions has become a national duty in many parts of the world.

It has been said that when food is unrestricted and the appetite is of the healthy, juvenile character there need be little fear of undernourishment. But delicate children do not always have a normal appetite, and when the food distribution is controlled as it is in public institutions, when a free choice or an unlimited supply is not always permitted, the possibility of error expressed in malnutrition or retarded growth is ever present. It is peculiarly timely, therefore, that a summary of the best evidence now available has been published by the New York Association for the Improvement of the Condition of the Poor. Its avowed object is to furnish a survey of the literature, observation, and experiments pertaining to the food requirements of children so that it will become easier to make an intelligent allowance for the adequate nourishment of children and at the same time to reach as many needy families as possible.

The statistics collected in the New York survey of the evidence regarding food allowance for healthy children represent the indications fur-

³⁶ *Journal of American Medical Association*, June 9, 1917.

nished by three independent types of investigation, namely: (1) Dietary or observation studies in which the weight of the food eaten by the subject was recorded for a given period of time and the food values either determined by analysis or more commonly calculated from figures representing average composition; (2) metabolism or balance experiments in which the intake and output were compared by determining chemically the composition of both the food taken and the excretory products, thus showing the amount of nitrogen retained in the body for growth of protein tissue; (3) respiration experiments in which the actual heat produced by the body was either measured directly in an air-tight chamber impervious to heat or calculated from the amount of oxygen consumed and the carbon dioxide exhaled. Since it is known that the oxidation of food yields energy, it follows that a measurement of the oxidation of foodstuffs in the body will give the amount of energy produced. This is usually and most conveniently expressed in calories. In a general way the available data furnished by these three somewhat unlike methods of approach are quite similar. The average may be summarized as follows:

CALORY REQUIREMENT OF CHILDREN AT DIFFERENT AGES.

Age in years.	Calories	
	Boys.	Girls.
From 2 to 5	1309	1245
From 6 to 9	1797	1575
From 10 to 13	2337	2015
From 14 to 17	2534	2253

It will be noted that there is a difference between the requirements for children of the two sexes. It might be thought that this is due solely to the difference in size at the same age. This seems less likely at present than the assumption of unlike bodily activities, on which a part, at least, of the different needs depends. It is believed that the two sexes have the same basal requirement; that is, the amount of energy required for the maintenance of such internal activities as respiration, heart beat and circulation of the blood and attainment of suitable muscular tone is comparable.

Age is the largest factor in determining the food requirement of the young. Per unit of weight the amount of energy required for "the mere processes involved in remaining alive"—in other words the basal need—decreases with increase of age. Although these facts have long been recognized, the unusually conspicuous activities of growing children, a factor added to age and size have not been so thoroughly appreciated in taking account of the proper food demands of the young. To this must be added further the requisite quota for increment of tissue or growth. Gillett has further pointed out that greatly emaciated children with depleted tissues, which can and ought to be rebuilt rapidly, should receive a more liberal food allowance than would be required by normal children either of the same age or of the same weight. If suitable nutritive conditions are established, recovery or repair can proceed at a speed out of all proportion to the usual rate of growth at the same age.

In view of these considerations involving features that are highly important rather than novel, we are admonished to adopt the recommendation of Sherman that the food requirement (calories per day) of each member of a family be estimated on his own merits. A small, inactive man may require less than a large, active boy or girl. This should be recognized and provided for. The upshot of the New York survey has been the compilation of a new set of "standards" which deserve widespread recognition because of the care and intelligence with which they have been prepared.

FOOD ALLOWANCES FOR CHILDREN.

Age in years.		Calories per day.	
		Boys.	Girls.
Under	2	900 to 1200	900 to 1200
From	2 to 3	1000 to 1300	980 to 1280
From	3 to 4	1100 to 1400	1060 to 1360
From	4 to 5	1200 to 1500	1140 to 1440
From	5 to 6	1300 to 1600	1220 to 1520
From	6 to 7	1400 to 1700	1300 to 1600
From	7 to 8	1500 to 1800	1380 to 1680
From	8 to 9	1600 to 1900	1460 to 1760
From	9 to 10	1700 to 2000	1550 to 1850
From	10 to 11	1900 to 2200	1650 to 1950
From	11 to 12	2100 to 2400	1750 to 2050
From	12 to 13	2300 to 2700	1850 to 2150
From	13 to 14	2500 to 2900	1950 to 2250
From	14 to 15	2600 to 3100	2050 to 2350
From	15 to 16	2700 to 3300	2150 to 2450
From	16 to 17	2700 to 3400	2250 to 2550

Quoting the report, the limits given make allowance for individual variation. If a child is tall and growing rapidly at six years of age he may—and probably will—require 1600 calories. If of smaller frame, an allowance of only 1400 or 1500 calories will be necessary with a normal amount of activity. If he is both large for his age and very active, he will doubtless require the upper limit of the allowance, 1700 calories. It will be seen that this range of calories may be used to provide for the actual needs of each individual child at any age.

RHINOLOGY, LARYNGOLOGY AND OTOTOLOGY.

By GEORGE M. COATES, M.D.

MILITARY OTOLARYNGOLOGY.

DURING the first two years of the war in Europe the foreign special journals, those of them that survived and reached this country, contained comparatively few references to war surgery or war diseases, and of necessity little original research work of worth. This is easily accounted for by the general unpreparedness of the allied nations, necessitating the calling out of active professional life many former contributors, who found thereupon that it took time to orientate themselves, and to study the new conditions presented before attempting systematic reports. This condition has materially changed of late, and by far the majority of studies and case reports published abroad pertain to medicomilitary subjects. In this way much of value has been added to the sum total of our knowledge; valuable as showing, as never before, the results of war in general on the structures of the head and respiratory organs, as well as the results of this modern, most scientific, system of killing and maiming that is being practised at the present time. Many lessons for civil practice in the future may be learned thus, and particularly to those of our number who, either abroad or at home, will be called upon to treat these cases, either in the acute stages of their injuries on the battlefields, or in the trenches; or, more remotely, in the reconstruction hospitals at home, will these constantly increasing reports be of value.

The allies long ago realized that special surgery, by experts in their respective branches, was needed in order to do one or all of three things which the general surgeon often could not do in injuries of this class, namely, to save life, to return the stricken soldier to effective duty at the earliest possible moment, or, if incapacitated for further military activities, to repair him so that he might take his place in society without horrifying disfigurement, and be capable of more or less self-support. Following this line, groups of specialists have been gathered together in great hospitals abroad to care for certain classes of injuries, and splendid work has been done, notably in orthopedics in Great Britain. It was found, however, that owing to inadequate preparation, many men were taken into the allied armies with defects that later on, under conditions of extreme hardship and exposure, seriously affected the health of the individual and the effectiveness of the command containing him, as well as overcrowding the already congested hospitals. This was especially true of the British practice of accepting for service men with chronic suppurative otitis media and other chronic infections of

the nose, which resulted in an undue amount of mastoiditis with its accompanying complications. Moreover, it has been realized lately that in injuries of the head, as well as of other parts of the body, the specialist in a remote base or reconstruction hospital did not see his case in time to obtain the best possible results.

Shortly after the entrance of the United States of America into the war, the great special societies, the American Ophthalmological, the American Laryngological, the American Otological, the American Laryngological, Rhinological and Otological, and the College of Surgeons appointed committees to take up with the Surgeon-General the possible employment of the specialists of the United States. Each of these societies was soon after represented on the Council of National Defense, and plans were then formulated whereby it is hoped that the wounded soldier will receive the best special attention from the time of his injury at the front until he is discharged from the remotest base or reconstruction hospital. In the old army, the division of services was simply into medical and surgical sections, with such subdivisions as the laboratory in later years, but very little attention was paid to the other special branches, and it was therefore with some difficulty that the adoption of the above general plan was obtained. With the great increase in the army, however, many thousands of physicians from civil practice came forth and were accepted for volunteer military service in the Medical Corps of the National Guard and the Reserve, many of them specialists of the highest rank, so that it was at first a problem where to place them so that the greatest service could be rendered. With the advent and adoption of the plan to use specialists, whenever possible, in their own specialties, new bureaus were created in the Surgeon-General's office to tabulate, assign and equip these volunteers, and their plan is at the present writing well on the way to accomplishment.

The establishment of Sections for Surgery of the Head is of peculiar interest to all otolaryngologists. It is intended that every base hospital, either at home or overseas, shall include such a section as one of its separate departments, ranking equally with the old medical and surgical sections, and the new ones devoted to orthopedics, venereal and skin, laboratories and infectious diseases, neurology and psychiatry, and roentgenology, and in charge of a chief of service. The original Red Cross Base Hospitals included in their personnel only one otolaryngologist and one ophthalmologist.

It is estimated¹ that about 20 per cent. of the beds in base hospitals in the war zone is employed in the treatment of head injuries, in spite of the general use, since early in the war, of steel helmets. There should therefore be ample work for these head sections to do. The special Section of Surgery of the Head is divided into the following divisions: otolaryngology, ophthalmology, brain surgery and oral and plastic surgery. These sections are under the general direction of Lieutenant-Colonel T. C. Lyster, U. S. A., of the Surgeon-General's Office, and associated with him are the following, forming a subcommittee of the

¹ Ophthalmic Record, October, 1917.

General Medical Board of the Council of National Defense: Major Harris P. Mosher, otolaryngology; Major Nelson M. Black, ophthalmology; Major V. P. Blair, oral and plastic surgery; and Captain Charles Bagley, Jr., brain surgery.

Through this committee some of our best-known specialists throughout the country have been drawn from the ranks of the National Guard or commissioned in the Medical Reserve Corps and assigned to the various National Guard Camps and National Army Cantonments as members of head surgery units, for purposes of training in military life and methods, including the abhorred army paper work, to guard the health of the men in training, to correct pathological conditions found that might menace the life or efficiency of the possessor, or secure his disqualification from service if uncorrectable, and in general to become acquainted with each other in order that the work may go on in harmony. This last feature is not to be taken too lightly when it is considered that the work of all must be done on such a limited field as the head, where everyone of the subsections overlaps every other.

A plan is also under consideration whereby at least one large hospital in France is to be devoted entirely to injuries of the head. To this hospital all such cases will be evacuated from the advanced base hospitals when deemed to be to the best interest of the service and of the individual. The service of such specialized surgery at the front may proceed along three lines:

1. Immediate service, or first aid, at the nearest dressing station.
2. Service in the base hospital, where all operative procedures of these types of special surgery can be done deliberately and the cases watched for an adequate length of time.
3. Final service in special hospitals devoted to reconstruction and reëducation, probably placed in this country.

The *raison d'être* of these sections is well stated by Lieutenant-Colonel Lyster as follows: "The physical disasters which the present war occasions are more severe and more specialized than those of any other war. The men who fight have a right to expect that the physical distress which such combat entails shall be alleviated by means as scientifically accurate as those which can be commanded by the civil population. The vital necessity of ophthalmoscopic examination by the ophthalmologist in the work of brain surgery; the need of prompt release by the brain surgeon of increased intracranial pressure to save eyesight; the value of expert examination of the ears by the trained otologist in the elucidation of problems of neurology and cerebral surgery; the need of search by the expert rhinologist and oral surgeon for foci of infection in the accessory sinuses, the tonsillar tissues and the dental areas are well known."

Not a little of the work of the ophthalmologist and otologist in National Guard Camps and National Army Cantonments is the determination of those physically disqualified for service and the elimination of the *malingeringer* from this class. The Surgeon-General's Office has officially adopted the use of the "Wagner Malingeringer Phone"² for

² Illinois Medical Journal, September, 1916.

the detection of monolateral malingerers of deafness, a very common occurrence. Wagner classifies those patients who present themselves for such an examination in three groups:

1. Monolateral hearing absent, with, or without, objective findings due to the internal ear or nerve, and with other symptoms accompanying the lesion.

2. Monolateral hearing absent due to trauma to the auditory canal and middle ear.

3. Monolateral hearing absent due to an injury to the head, without any other accompanying symptoms or findings, except the history as given by the patient.

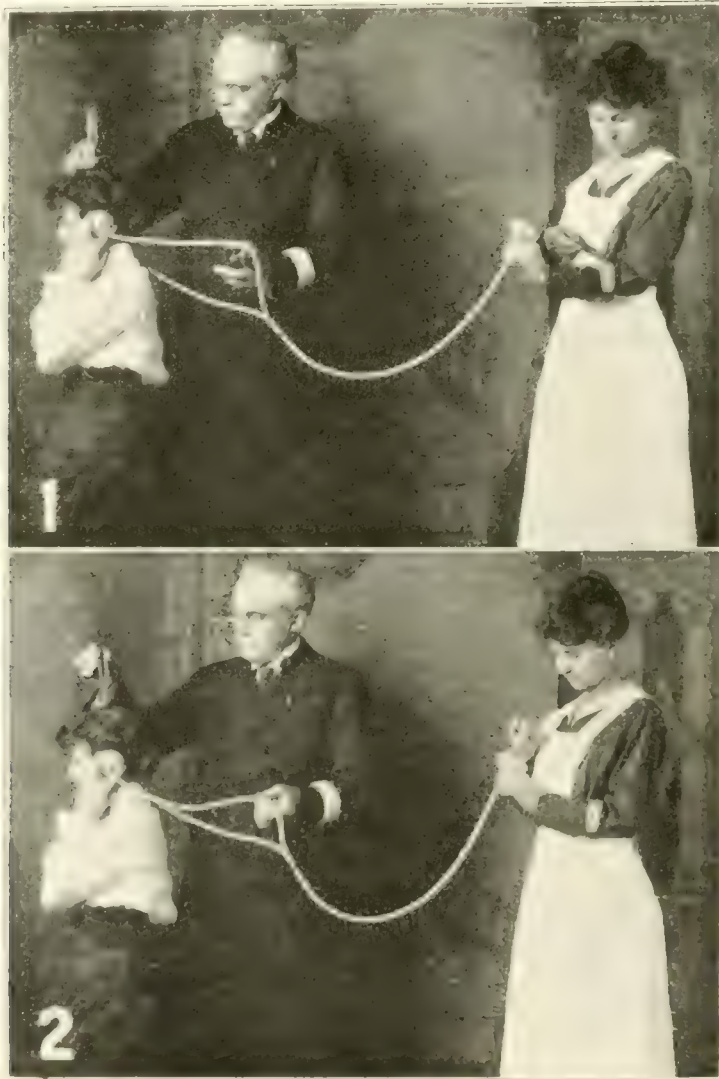


FIG. 9.—Shows operator conducting sound waves by bone conduction to the internal ear with a C2 fork. The assistant is seen to strike a C2 fork, and is getting ready to send the sound waves through the instrument by air.

FIG. 10.—Shows the conduction of sound waves by air by the assistant only. The tuning-fork by the operator is still on the head of the patient, but held so that it is not vibrating. With the left hand the operator is seen to compress the tubule which goes to the good ear.

The instrument is a funnel-shaped post, like the bell of a stethoscope, which receives the sound. This receiver is connected by rubber tubing with a metal Y-shaped tube from which again two rubber tubes extend

to two funnels large enough to cover the entire external ears. The tubing should be at least two meters in length.

The examiner places himself behind the patient with a C2 fork for testing bone conduction in the usual way. At the same time that the vibrating fork is placed on the skull, an assistant places a vibrating C2 fork at the receiving end of the phone, so that the patient now receives synchronous sounds by air and bone conduction, which is confusing. After some minutes of this the fork is placed on the head *without* vibrating, the only sound that reaches the patient therefore being that coming through the tube by air conduction. The tube leading to the hearing ear is occluded by finger pressure, and if the patient still admits hearing, malingering is proved.

In the French Army, deafness is classed as an exemption from military service when loud speaking is heard only close to the ear; it must be heard at about 4 or 5 meters for active military service. Dufourmentel³ cites 11 different tests for malingerers, some of which are novel and of interest to many who are now, in our own service, confronted with the often perplexing problem of possible malingering. The *cochleopalpebral reflex*, for instance, consists of involuntary winking when a sudden loud sound is heard close to the ear. This is satisfactory for simulated bilateral deafness, as is the Stenger or double-fork test, for unilateral simulators. Advantage is taken of the fact that a simulator does not learn to read lips like the truly deaf, and therefore if a noise drowns what is being said, he fails to read, showing that he was depending on his hearing rather than his vision.

Another form of malingering in order to be placed on the sick list is described by Torregiani⁴ and consists of rubbing various varieties of euphorbia on the ears. This gives rise to a severe inflammation of the auricle and external canal, even ulceration being produced at times. We are, I suppose, all familiar with the type seen in our city dispensaries where young men of foreign birth have punctured the ear drums to avoid military service. It is astounding to see what some men will resort to in order to avoid being drafted, though I have heard of little or none taking place in our recently conscripted army.

Shell Shock. Many references appear in current literature of the past year to shell shock, and its effect on the organ of hearing. Macleod Yearsley⁵ reports such a case from the air raid of June 13, 1917, when a bomb was dropped in the vicinity of a school teacher in London, the resulting explosion bursting in the door and knocking her down. Though not losing consciousness, she was markedly deaf, with loud ringing tinnitus, without vertigo. Both tympanic membranes showed marked retraction, Weber's test was neutral and Rinne was just positive to C128 fork on both sides. High tones were heard at 15,000 double vibrations and whisper at 7 feet right 25 inches left. The case was diagnosed as acute depression of the tympanic membranes from sudden increase of external pressure. The functional tests indicated a middle-

³ Paris médical, September 1, 1917.

⁴ Arch. ital. di otol., rhinol. e laryngol., October, 1916.

⁵ Journal of Laryngology, Rhinology and Otology, September, 1917.

ear condition (by increased bone conduction and loss of low tones), but not a very marked or long-standing one (Rinné reaction still positive, bone conduction only slightly increased) and no implication of the labyrinth. This case improved rapidly under middle-ear treatment, and Yearsley questions whether the proportion of such cases of middle-ear deafness to labyrinth concussion after exposure to high explosives may not be higher than supposed previously.

J. G. Wilson⁶ feels that in considering DEAFNESS DUE TO HIGH EXPLOSIVES the term "shock," as well as the term "hysteria" and "neurasthenia," should be avoided so far as possible. He divides those cases admitted to hospital suffering from "nerve deafness due to shell explosion" into three classes:

1. Those with nerve deafness.
2. Those who have had nerve deafness of varying degree and who still have the fixed idea that they cannot hear.
3. Malingerers.

Class 1 is again subdivided into three groups.

1. Cases of combined damage to the conduction and perception mechanism.
2. Cases of nerve deafness without visible or demonstrable lesion of the conduction mechanism.
3. Cases in which there is total destruction of the cochlea and semi-circular canals or their nerves.

Of course, in the latter class, deafness is absolute and permanent.

The symptoms associated with loss of hearing from high explosives may be classed as those of traumatic neuroses. They present exaggeration of the tendon reflexes, tremors, vasomotor disturbances, sweatings, lethargy, insomnia and headaches, often vertigo, and a concentric narrowing of the visual field. Often fields of anesthesia are present, and in 2 cases of total deafness there was complete anesthesia and loss of thermal sense. Sometimes hyperesthesia is present. As a rule the prognosis in these cases is considered good, except as noted in those of class 3, especially where the caloric reaction is normal. It would seem that where one part of the labyrinth is injured the other must be also, as Dan MacKenzie⁷ even goes so far as to believe it possible that the shock or "alarm" induced by a loud sound may be partly due to impressions conveyed not only through the cochlea but also through the semicircular canals. He conceives it difficult, in view of the close union of the vestibular and cochlear end-organs, to escape from the idea that as they lie in such close proximity and in contact with the same body of fluid, so their functions must be similarly united at times.

Wilson⁸ also observed a large number of cases of deafness from high explosives within from twenty-four hours to a week after the injury was inflicted. Of 50 complaining of deafness, 17 showed demonstrable signs of injury to the internal ear traceable to the explosion. He states that exposure to these terrific explosions may produce rupture of the

⁶ British Medical Journal, March 17, 1917.

⁷ Journal of Laryngology, Rhinology and Otology, September, 1917.

⁸ Journal of American Medical Association, June 9, 1917.

tympanic membrane which tends, in most cases, to spontaneous closure. The most satisfactory treatment is rest in bed for a number of days and no disturbance of the clot covering the perforation. Associated with these perforations there may be concussion of the internal ear, or the latter may occur without perforation. Nerve deafness and vertigo are apparent in these cases, which may remain after the concussion has passed off.

That in some cases of shell shock the injury is even more deeply seated is evident by a report of von Sarbo,⁹ who finds there is often actual damage to the centers of the eighth, ninth, tenth and twelfth nerves, causing deafness and loss of speech as a result of the driving of the medulla into the foramen magnum and the cerebrospinal fluid into the fourth ventricle; or there may be a fracture of the base of the skull, with injury to the nerve centers in the medulla. Even in these cases the prognosis is considered, as a rule, good. Indeed, Launois and Chavaune¹⁰ report complete recovery in all but 2 per cent. of 645 cases of more or less total deafness caused by a concussion of the internal ear without direct traumatism.

Ranjord¹¹ classifies these injuries into organic when the organ of Corti is injured, and neuropathic when there is inhibition of auditory sensation. The organic form is associated with otitis media, labyrinth concussion or auditory neuritis, while true neuropathic deafness is usually accompanied by mutism, is bilateral, and complete for all sounds, and shows no vestibular disturbances. In fact, most of the ear injuries due to high explosives seem to be confined to the internal ear, there being relatively little middle-ear damage. Saupiguët¹² notes comparatively few out of a large number of cases of ear disease produced by what he calls *aërial commotion*. Those showing perforation often healed spontaneously, but also quite often became infected and ran the usual course of middle-ear suppuration. Other cases showed no perforation at first, but instead an intratympanic hemorrhage or a hematoma, which either cleared up in a few days or else degenerated and perforated.

During previous wars it was customary for those soldiers serving big guns to place cotton in their ears in order to avoid ear trouble caused by explosions. If one had the time it was also recommended that he stand on tiptoe and hold his breath with his mouth open in order to if possible neutralize the concussion. During our war with Spain, I remember distinctly trying to follow these instructions, but with little success after the firing became rapid, since one would have had to hold his breath continuously. The idea that had its origin in the old plug of cotton has, however, developed and been made use of by Verain,¹³ who has introduced "shock absorbers" in the form of hollow celluloid or metal olive-shaped cones about 12 x 9 mm., provided with a transverse septum inside, acting somewhat in the manner of a silencer or muffler. This does not interfere with the hearing of commands, although the air shock

⁹ *Medizinische Klinik*, September 17, 1916.

¹⁰ *Lyon Médical*, February, 1916.

¹¹ *Bull. de l'Acad. de méd. de Paris*, September 12, 1916.

¹² *Rev. de laryngol., d'otol. et de rhinol.*, December 31, 1916.

¹³ *Bull. de l'Acad. de méd. de Paris*, August 7, 1917.

is absorbed. Guild¹⁴ strongly urges the adoption and compulsory use of some such device to protect the ears of fighters in order to keep trained men in active service who might otherwise be incapacitated. He commends the use of the old cotton plugs soaked with petrolatum if nothing better can be obtained. There can be very little disagreement with this idea, and it should prove perfectly feasible.

The need of special institutions devoted to the care and training for future civil usefulness of the deaf soldier is just beginning to be realized in England, and steps are being taken to formulate plans having this object in view, as has already been done for the blind.¹⁵ It is contemplated having a number of such institutions widely scattered over the country whose first task will be to separate the functional from the organic defects. It is next proposed to provide the deaf with information as to what trades and occupations are suitable to them and to train them for those callings. Besides these very important functions, classes for the teaching of lip-reading will be formed. The British War Office and the Royal Army Medical Corps early realized that the responsibility of the Government to the wounded soldier did not cease until he was restored as nearly as possible to his normal earning capacity. Kidner¹⁶ tells how this work has been and is being accomplished in the department of orthopedics, which was naturally the first branch in which it was attempted and in which brilliant results have been obtained, there being now over 11,000 beds available for such purposes. It is inevitable, therefore, that the work should be extended and enlarged until all physical defects are being cared for, and those of the ear and the eye seem to have already been recognized as of prime importance. In view of the advent of our own troops at the front it would be well to take this experience to heart and provide facilities for the early care of these cases in our own country.

Stammering, aphonia and various speech defects as a result of the action of high explosives have received considerable attention by various surgeons in the belligerent armies, although no very great number has been noted by any one observer. Briand and Philippe¹⁷ indeed comment on the remarkably small number of such cases brought on or caused by the emotional stress of war. Many of such cases are mere relapses in those who had been stammerers in early life, and had conquered the tendency. The treatment recommended is the usual one in civil practice, consisting of breathing exercises, training in management of the diaphragm and so forth. Certain of these disorders are caused by actual paralysis of muscles or groups of muscles needful for speech production, such paralysis being caused in some instances by prolonged exposure and fatigue, great emotional excitement, or the action of high explosives. Liebault and Coissard¹⁸ give the treatment in great detail and lay especial stress on the use of the mirror in the process of reëducation, the method being identical with that in use in the work of the late G.

¹⁴ *Journal of Laboratory and Clinical Medicine*, September, 1917.

¹⁵ *Journal of Laryngology, Rhinology and Otology*, July, 1917.

¹⁶ *Journal of American Medical Association*, October 6, 1917.

¹⁷ *Progrès médical*, Paris, July 28, 1917.

¹⁸ *Rev. de laryngol., d'otol., et de rhinol.*, February 15 and 28, 1917.

Hudson-Makuen in the Philadelphia Polyclinic, and used by other workers in defects of speech in this country.

Liebault¹⁹ states that many of the men who have lost their voices in the war attribute their aphonia to commotion or nervous traumatism caused by shell explosion, although in most cases it comes on gradually without shock. Many of them also come to the reëducation clinic with a diagnosis of tubercular laryngitis. While the evidences of overstrain of the voice or chronic laryngitis are frequent and marked, most of them clear up readily with appropriate treatment by phonetic reëducation, and a true "bacillary laryngitis" is not so often seen. When the mirror shows a normal larynx, except for a paresis of the constrictor (adductor paralysis), the case is considered one of pure nervous aphonia curable by ordinary care and reëducation. A number of writers advocate the use of general ether narcosis for this condition. Milligan²⁰ has dealt with a number of such troublesome cases, the worst of which were caused by the soldier being buried as the result of a shell explosion and where the usual methods of drugs, painting the larynx, electrodes, etc., have failed. The patient is etherized and as he is coming out of the anesthesia a spatula is introduced into the larynx and moved about, whereupon he usually shouts and is kept shouting until he is far enough out to be aware of what he is doing, when a cure is recorded. Moriondo²¹ finds this method of great value in cases of mutism, aphonia and deafness of psychoneurotic origin resulting from shell shock. Pansera²² records a case where a similar treatment was successful, and Penhallow²³ thinks that general narcosis with ether is the most valuable means we have of effecting a cure in many of these cases and often succeeds after the failure of all other methods.

Examination of Aviators. During the early period of the mobilization of our forces for training purposes, aviation schools were established and numbers of the youth of the country offered their services for air work. The government decided that only those who were perfectly fit mentally and physically could be accepted and strenuous tests were used, particularly for the vision and for the function of maintaining equilibrium. Isaac H. Jones,²⁴ who has done much to disseminate knowledge of the functions of the static labyrinth in this country, describes the method of making such tests on aviator applicants and deems it of the utmost importance that an aviator should have a perfectly balanced mechanism for the maintenance of his equilibrium, for, when once in the air, two of the three senses by which equilibrium is maintained are lost—namely, the muscle sense and (in smoke, clouds, or at night) the sight. To accomplish this, examining depots were established in all the large cities, where recruits could be examined by expert otologists trained in making the so-called Bárány functional tests of the static labyrinth. It was, moreover, found necessary to standardize these

¹⁹ *Rev. de laryngol., d'otol., et de rhinol.*, October 31, 1916.

²⁰ *Proceedings of the Royal Society of Medicine, Laryngology Section*, April, 1916.

²¹ *Arch. ital. di otol., rhinol. e laryngol.*, November, 1916.

²² *Polielinico*, December 10, 1916.

²³ *Boston Medical and Surgical Journal*, January 27, 1916.

²⁴ *Journal of American Medical Association*, November 10, 1917.

required tests and also to standardize the examiners. The vision of the recruit must be perfect, 20/20 without glasses and he must have 40/40 hearing and must be perfect physically. On the official blank, the following equilibrium and vestibular tests must be made and recorded:

The nystagmus, past-pointing and falling after turning are tested. The turning-chair must have a head-rest which will hold the head 30 degrees forward, a foot-rest and a stop-pedal. (The American Modification of the Bárány chair is officially required. This made possible the establishment of an absolute standard. While the tests could be made by using other types of turning-chairs, an exact quantitative estimation of the responses can be definitely established only by the use of a standardized chair.)

(a) **NYSTAGMUS.** First of all, a spontaneous nystagmus must be looked for. It is noted whether there is any twitching of the eyes when gazing straight ahead, or looking either to the extreme right, the extreme left, up or down. With the head forward 30 degrees, the candidate is turned to the right, eyes closed, ten turns in twenty seconds. The instant the chair is stopped, the stop-watch is clicked; the candidate opens his eyes and looks straight ahead at some distant point. There should occur a horizontal nystagmus to the left of twenty-six seconds' duration. The candidate then closes his eyes and is turned to the left; there should occur a horizontal nystagmus to the right, of twenty-six seconds' duration. A variation of ten seconds is allowable (either as low as sixteen seconds or as high as thirty-six seconds).

(b) **POINTING.** 1. The candidate closes his eyes, sitting in a chair facing the examiner, touches the examiner's finger held in front of him, raises his arm to the perpendicular position, lowers the arm, and attempts to find the examiner's finger. This is done first with the right and then with the left arm. The normal person is always able to find the finger.

2. The pointing test is repeated after turning to the right, ten turns in ten seconds. During the last turn, the stop-pedal is released, and as the chair comes into position, it becomes locked. The right arm is tested, then the left, then the right, then the left, until candidate ceases to past-point. The absolutely normal will past-point to the right three times with each arm, if needless delay is avoided. (However, one past-pointing to the right of each arm qualifies, if the nystagmus and falling are normal.)

3. The past-pointing is repeated after turning to the left. (Similarly one past-pointing of each arm to the left qualifies, if the nystagmus and falling are normal.)

(c) **FALLING.** The candidate's head is inclined 90 degrees forward. He is turned to the right, five turns in ten seconds. On stopping, the candidate quietly sits up, eyes closed, and should fall to the right. This tests the vertical semicircular canals. He is turned to the left, the head forward 90 degrees; on stopping, he again sits up, and should fall to the left. If, in these tests, the candidate shows normal responses, he is fit for the Aviation Service; if he does not, he is unfit. It is, of course, not intended to make a diagnosis of any pathological lesion that so disqualifies him.

Standardization of examiners was accomplished by sending a specially qualified medical officer to thirty cities throughout the United States to establish examination units for these candidates, in many places the large hospitals and teaching institutions being utilized for the purpose because of their availability and equipment.

A communicable disease prevalent, at least among the British troops, is

Ulceromembranous Stomatitis and Gingivitis. Bowman²⁵ states that it is a sequella of pyorrhea alveolaris, and that the same organisms are found, and, in addition, the organisms of Vincent's angina. It spreads from the gums to the mucous membrane of the cheeks, tonsils, tongue and pharynx forming superficial ulcers covered with white, friable membrane, easily removed, and leaving a bleeding surface. The gums bleed easily, are retracted from the teeth, the latter becoming loose and sensitive. The breath is fetid and there is some adenitis and at times a rise of several degrees in temperature.

Plastic Surgery. Naturally, plastic surgery of the head and face has taken a prominent place in the medical history of the war and some of its most brilliant achievements have been in this line, mostly by American surgeons assisted by American dental surgeons. This combination has, indeed, proved so effective, that the Head Surgery Sections mentioned above make provision for this work in conjunction with the laryngologist. Naturally, much of this work in the future will be done by the laryngologist himself, and the importance of such restorative work on the face cannot be overestimated. It is a revelation to see the "before and after" photographs of some of these cases. Bersani²⁶ takes this view of the coöperation of dentist and surgeon. His plan is to use copious irrigations of physiological salt solution for the inevitable infection and the avoidance of any removal of fragments or teeth that may be retained and used later in the reconstruction. Even very loose teeth may be made firm again, but it is not considered advisable to do much suturing, either of soft or bony parts, at the beginning of treatment, although it is important that fragments be placed in position so far as possible. He considers wounds of the superior maxilla less severe than those of the lower jaw, even if the antrum is involved. Gillies²⁷ reports a number of typical cases illustrating this plastic reconstruction work and the standard principles employed. With destruction of the bridge of the nose, the septum may be rebuilt by throwing forward a part of the perpendicular plate of the ethmoid and bringing forward flaps from the cheeks to form a new bridge, wire retention sutures meanwhile relieving the strain on the flaps. Rib-cartilage grafts further raise these depressed bridges, and transplantations of parts of the temporal muscle are utilized to fill in cavities caused by loss of the malar bone. For this latter operation a U-shaped incision in the hairy scalp exposes the temporal muscle, the anterior two-thirds of which is dissected loose from the bone, passed under the bridge of skin and sutured to the deep tissue below the eye. Drainage from the hollow produced by the transplantation seems

²⁵ British Medical Journal, March 11, 1916.

²⁶ Annali di odontologia, November, 1916.

²⁷ Journal of Laryngology, Rhinology and Otology, September, 1917.

to be necessary. In cases of great destruction of the mouth and jaw, numerous rebuilding operations are necessary, employing the accepted principles of plastic surgery, and great patience and painstaking skill are necessary to correct the deformities.

ASPHYXIATING GAS. The element of frightfulness in the present war is not caused alone by the terrible deformities caused by high explosives and shrapnel, but also by the use of liquid fire and gases, of which there are three types, the asphyxiating, the lacrimatory, and the paralyzing. The latter is usually hydrocyanic acid fumes, arsene and phosphene, and kill quickly, while the lacrimatory, while causing great pain and loss of vision through swelling of the conjunctival mucous membrane, do no permanent damage, the effects being transitory. Gases of these two types are used only in shells, the asphyxiating gases being used both in shells and in clouds. The asphyxiating gases are mostly chlorine (bromine and iodine) and phosgene, though many others have been used at times. The chlorine combining with the moisture in the upper respiratory tract forms hydrochloric acid which damages the tissues, often beyond recovery. The effects are practically acid burns of all mucosa affected producing edema, epistaxis, cyanosis and death. The symptoms appear at once (except when phosgene is used) and if the patient survives two or three days, the mortality is not high. Phosgene, on the other hand, produces no effect at first and is not even noticed, being odorless, colorless and tasteless, but, decomposing slowly in the mucous membranes, produces the same effects at an interval of about twenty-four hours. Now that efficient gas masks and regulations are in effect in the allied armies, not many cases of "gassing" occur.

The treatment, as well as the cause, of this condition is interesting to laryngologists. Colard and Spehl²⁸ describe this condition as of three types:

1. A brutal and subacute asphyxiated condition from massive intoxication with intense cyanosis, froth on the lips and vomiting of blood, with rapidly fatal outcome.

2. An acute state of asphyxia developing in those who at first did not seem to be severely gassed. The intense cyanosis and changes in the pulse and respiration are characteristic.

3. A clinical picture of tracheobronchitis from caustic action characterized by inflammation of the large and small bronchi and of portions of the lungs, but with enough sound tissue left to aerate the blood.

The treatment consists primarily of *venesection* which must be done at the earliest possible moment and at least 300 c.c. of blood drawn, repeated if necessary. Such blood is blackish in color and flows slowly. Next in importance is the administration of *oxygen*, and it must be used for hours or days under moderate pressure and until all alarming symptoms are past. The most convenient way to administer oxygen is to pass it through a Wulff jar to clarify and moisten it, and then through three or four tubes to as many patients. A catheter is passed into the nasopharynx through the nose and fastened with adhesive, and through this the oxygen passes with no discomfort to the patient. About 100

²⁸ Arch. médicales Belges, July, 1917.

to 150 liters per hour are needed. Peace, quiet and fresh air are essential, and air kept moist with a eucalyptol spray has proved useful. Instillation of medicated oil into the nostrils, and the inhalation of tincture of benzoin and eucalyptus complete the list of remedial measures. In the treatment of a vast number of cases who reached the hospital, Colard and Spehl did not lose a man, as the rapidly fatal cases succumbed on the field.

THE NOSE.

External Deformities. W. W. Carter²⁹ has reviewed his cases, 61 in number, where he has operated to correct external deformity of the nose, and gives his conclusions based on serial roentgenological studies extending over a period of seven years in the oldest cases. He endeavors, in this way, to show the true value and permanent qualities of bone and cartilage as transplants in the correction of nasal deformities and defects due to destruction by disease, or traumatism, of the bony and cartilaginous framework of the nose. In these cases he has used bone transplants both with, and without, periosteum, with, and without contact with the living skeletal bones. Reliable data can only be secured by studying the progress of a number of cases after the ideal operation, and by ideal operation one is meant in which an autogenous transplant has been introduced aseptically in such a position that perfect immobility has been secured, and of all places in the body the nose is best adapted to securing these conditions. It is considered that the autoplasmic transplantation is the best method, since heteroplasmic transplants are always absorbed, autoplasmic ones, on the contrary, living and remaining intact, as shown by radiographs. For most cases, especially when the deformity is marked, and for the external operation the technic is now well known, Carter finds the rib best for transplanting purposes, although other operators prefer the tibia, owing to the danger of perforating the pleural cavity when the portion of rib is excised. The rib, however, is abundantly supplied with nutrient foramina, is properly shaped, is easily accessible, and the removal of a section causes little inconvenience since the defect is quickly filled in by bone developed from the stumps of the rib. Moreover, the transplant can be made partly of bone and partly of cartilage, which serves to maintain the flexibility of the nasal tip. It is essential that there should be no manipulation of the nose following operation, and that there should be no early exposure to the *x*-rays, since that may delay the healing process. Lately, as mentioned in this chapter last year, Carter favors the intranasal route, which is, briefly, as follows: The left nasal cavity is sterilized and the tip of the nose raised. A spatula-shaped knife is introduced through the roof of the nasal cavity at a point corresponding to the interval between the upper and lower lateral cartilages. Through this opening the tissues over the dorsum of the nose are elevated and a pocket is also made down toward the tip. The transplant is introduced; then,

²⁹ Transactions of the American Academy of Ophthalmology and Otolaryngology, December, 1916.

by pulling on the tip of the nose, the lower end is slipped into its pocket near the tip.

No suture is used, and the nostril is packed for 24 hours with "petrolatum gauze." He feels that this method is far preferable to the external operation, as better drainage is secured and there is little danger of infection. Also there is no external scar. If there is marked deformity, several pieces of bone may be superimposed on each other, the outer one only retaining the periosteum. In addition, the small fragments possess relative greater osteogenetic power than the large ones. Often it is possible to utilize a spur, removed at the time of operation, for this purpose in place of the rib fragment. Based on this study of these cases he concludes that:

1. Bone and cartilage present about the same vitality and resistance to infection.

2. Infection occurring in the wound does not necessarily mean the destruction of the entire transplant, if the infection is quickly controlled. But a part, at least, of the transplant will be absorbed.

3. A transplant, stripped of its periosteum, and placed in the soft tissue of the nose, one end being contacted with live bone covered with periosteum, is osteoconductive and osteogenetic and is not absorbed. It does not, however, exhibit the vigorous growth noted in transplants covered with periosteum.

4. Transplants that are covered with periosteum and which are contacted with live bone covered with periosteum, continue to live and perform their function uninfluenced by their change of position in the body. This is the ideal transplant for use in all departments of surgery.

5. The periosteum *per se* does not reproduce bone.

He concludes, therefore, that, while the periosteum is necessary to the vigorous growth of the bone, bare compact bone takes an active part in the production of bone.

Babcock³⁰ is not in accord with Carter in his belief that the transplant must be autogenous, and has even gone so far, in supplying defects of the skull and face, as to use "soup-bones" taken from the hospital "soup-kettle" with good results. In 5 cases he obtained a prosthesis by embedding under the scalp or skin such pieces of alien and devitalized bone. He thinks it quite possible that his results may be due to the fact that his experiments were made on bones developed from membrane rather than on bones developed from cartilage—the long bones. This method was first used to correct defects in the skull, with the following technic: A bone taken from the soup-kettle has less animal matter than a fresh bone, but it must not have been boiled long enough to make it brittle. The scapula of a sheep or ox is preferred on account of its size, thinness and porous medulla, and such a bone is rinsed, reboiled for one hour in a large quantity of water, and then placed overnight in a 1 to 20 solution of phenol. Previous to the operation it is again boiled for at least half an hour in plain water. The bone is now free from most of the animal matter, and is so softened that it can be readily cut in any shape required with stout scissors. If now it is to be used to supply a skull

³⁰ Journal of American Medical Association, August 4, 1917.

defect, preparation to receive it is made by raising a skin flap, separating the periosteum well back from the margins of the defect and fastening in with sutures, the dead bone in contact with the living. It is important to obtain absolute hemostasis, as no drainage is used. He states that the bone soon becomes fixed in its new position and is probably early permeated by new bloodvessels.

Babcock considers that "soup-bone" prosthesis seems to be deserving of a trial in the correction of osseous deformities of the face and jaws, such as saddle-nose, defects in the supra- or infra-orbital ridges, depression in the malar or supramaxillary regions, loss of the zygoma, etc.—in other words, just the injuries most often experienced in war. If there is anything in the method, it offers an easy method of solution of various problems that will soon be confronting our plastic surgeons in the war hospitals. He has used it successfully in 2 out of 3 cases of saddle-nose, the spine of the scapula being employed. His technic is simple in this operation, as he makes an incision in a skin wrinkle in the forehead and uses Mayo scissors to elevate the skin over the bridge of the nose. The devitalized bone splint is now inserted and contacted with the nasal and frontal bones, and the initial wound closed with horse-hair sutures. In one of these cases no evidence of absorption was observed after the lapse of two years.

HEMORRHAGE. The use of various biological substances for controlling hemorrhage has received a good deal of attention during late years, and, of all these, *thromboplastin* has probably been the most discussed by nose and throat surgeons owing to the difficulty experienced at times of arresting hemorrhage from the upper air passages.

Hess³¹ has studied the action of this substance and comes to the conclusion that it is effective in a large percentage of cases, but only if it can be brought into direct contact with the bleeding-point so that all clots should first be removed before its application. It is regarded by him as almost a specific in controlling hemorrhage in hemophiliacs, in which cases it undoubtedly shortens the coagulation time, although it must be kept in contact for a longer period than in other cases. This "tissue juice," made from brain substance can be kept on hand for emergency, as it loses but little of its potency as a result of dilatation and cursory boiling. Weinstein³² corroborates Hess's experience and also recommends hypodermic injections of *emetine* as a routine before operation, by which the bleeding time is reduced at least one-third. The same result was obtained from *pituirine*, although it is not considered quite as reliable as *emetine*.

Chester C. Cott³³ has taken up the subject of SEPTAL HEMORRHAGE, of which the most frequent cause is said to be xanthosis in which a yellowish area appears at Kisselbach's area on the cartilaginous septum, either a straight or deflected one. This yellowish spot becomes an ulcer from which the bleeding occurs. The treatment recommended by Cott, and in a later article by Leshure,³⁴ is to raise the edges of the ulcer

³¹ Journal of American Medical Association, December 9, 1916.

³² Laryngoscope, March, 1917.

³³ Journal of American Medical Association, December 2, 1916.

³⁴ Annals of Otology, Rhinology and Laryngology, June, 1917.

for a considerable distance from its margin by a submucous resection and pack iodoform gauze into the cavity thus made. The packing is left in for two days, and the epistaxis is instantly and permanently cured. Leshure modifies the procedure by simply compressing the elevated flap of mucoperichondrium between the smooth flat blades of a specially constructed forceps and then packs the flap back against the cartilage for twenty-four hours, and the operation may be done under local, general or combined, anesthesia according to the type of patient, and hypodermics of morphine and adrenalin are found useful.

The Accessory Sinuses. Again a year has passed without anything startlingly new in the matter of diagnosis or operative procedure on the nasal sinuses. That much yet remains to be accomplished is pointed out by H. W. Loeb³⁵ after a review of the accomplishments of the past. As subjects for future investigation and report on the sphenoid sinus, he suggests that the cause of the excavation of the sphenoid body, resulting in the formation of these sinuses, with such a variety in size and shape, should be sought; and also why the posterior cell of the ethmoid sometimes projects itself into the sphenoid and replaces the corresponding sphenoid sinus. What bearing has the sphenoid sinus on the cranial nerves in the neighborhood, and are they susceptible to the influence of purulent infections of the sinus. Studies on the physiology of the sinus should be made, as no progress has been made in this respect for nearly three thousand years. Further needs are a better classification of the symptomatology of sphenoid disease, and a classification of the chain of nervous symptoms, headache, etc., that sphenoid operations for their relief may be rational and not experimental; better explanations of post-operative accidents and better means of diagnosing with certainty the presence of pus in the sinus.

Writing on Surgery of the Maxillary Sinus in the European War, Canuyt³⁶ strongly advocates using *local anesthesia* of the nerve-blocking type. His special method of procedure for inducing anesthesia is as follows: Novocain, 0.5 per cent. in adrenalin is used and the injection made into the trunk of the superior maxillary by way of the orbit. The point of entrance lies at the intersection of a line drawn from the superior border of the zygomatic arch and a line along the orbit or at the external angle of the orbit. The needle follows the floor of the orbit, pointing downward and backward toward the orbital fissure until a sudden loss of resistance is felt. The needle is held horizontally, the head being erect to avoid entering the subtemporal fossa through the inferior fissure. A penetration of 5 cm. should reach the nerve, and a successful injection is followed by complete anesthesia of the areas supplied by the superior maxillary nerve, and the corresponding portion of the face is blanched by the action of the adrenalin. If hematoma of the orbit occurs, it is soon absorbed. As an added precaution, the author of this method also injects 5 c.c. of solution at the exit of the infra-orbital nerve, 5 c.c. into the canine fossa and anesthetizes the mucous membrane of the nose in the usual manner.

³⁵ Journal of American Medical Association, December 30, 1916.

³⁶ Rev. de laryngol., d'otol., et de rhinol., January 31, 1916.

Skillern³⁷ also advocates the use of local anesthesia for the performance of the preturbinal, the Caldwell-Luc, or the Denker operations where the condition of the patient does not warrant a general anesthetic. He, however, induces anesthesia by infiltration of 2 per cent. novocaine and not by nerve blocking. As to the form of operation to be employed, he is guided by circumstances, such as the etiology, chronicity and course of the disease, the age, social and physical condition of the patient. If the disease is of undoubted dental origin, the diseased tooth must be sacrificed, and the canal enlarged into the antrum by the old Cowper method. Daily irrigations through this opening will effect a cure if the remainder of the antrum is not too extensively diseased. A sinusitis of four weeks' duration is usually classed as a chronic condition, although many cases may continue for weeks and still remain, to all intents and purposes, subacute—that is, but slight pathological change has taken place in the lining mucosa. The greater such a change may be, the more radical must be the type of operation chosen to effect a cure. If, therefore, the mucous membrane is enormously thickened and polypoid, or there are necrotic areas, the operation through the canine fossa, with thorough curettage, is considered the best. For that type of maxillary suppuration where lavage will control the disease as long as it is persisted in, but where relapses follow its discontinuance, the preturbinal operation through the crista pyriformis is the procedure of choice, since it is readily done under local anesthesia, there is no external scar, little tissue is sacrificed, the sinus can be fairly well inspected with the nasopharyngoscope, topical applications made, thorough drainage instituted, and above all, the patient very little incapacitated. He has never found it necessary to reoperate after this method has been used in the type of case to which it is applicable, but if it should be it in no way interferes with the performance of the radical, which, indeed, has already been half-done. In infants and very young children, suppuration is usually confined to the ethmoids, and a rapid exenteration of these under general anesthesia is all that is required. In older children, however, where the antrum is more developed, operative interference is frequently necessary because of the difficulty in carrying out more conservative treatment, and because, on account of the softness of the surrounding bony structures, of the tendency to osteomyelitis. A modified Denker operation is here the one usually chosen. On the other hand, in the old the drainage passages are frequently large and the type of disease not very severe, so that an intranasal operation is usually satisfactory.

Greenfield Sluder³⁸ describes a surgical procedure for what he designates the upper paranasal cells that, in many respects, is as unique as his other well-known procedures, and is based, like them, on a sound and intimate study of the anatomy of the parts for which it is proposed. While it apparently embodies some of the features of other operations, it is original in many ways and is commendable in that it makes for simplicity of armamentarium. The main feature is that the cut is made downward and forward, and therefore away from dangerous ground,

³⁷ *Journal of Laryngology, Rhinology and Otology*, January, 1916.

³⁸ *Annals of Otology, Rhinology and Laryngology*, June, 1917.

and constantly toward safer regions. In the *upper* cells he includes *all* the sinuses except the maxillary antrum. The instruments used are the Sluder knife (a very small right-angled hook sharpened on the inner or "pull" side), a Knight forceps, a snare, and, at times, a Sluder speculum which is a longer, stronger, wider-bladed model of the Killian. Special emphasis is laid upon the fact that proper models of the knives must be



FIG. 11.—On the right the angle knife is shown in the sagittal plane, ready for insertion under the middle turbinate. On the left it is shown in position for the forward and downward cut. It has been introduced into the infundibulum and rotated 30 degrees inward—*i. e.*, toward the septum nasi. The heavy lined *a-b* shows diagrammatically the line of this first cut, which may be accomplished in one stroke or two, according to the surgeon's election.

used. Too large a knife takes up too much space, bites more bone than it can cut, may inadvertently enter the orbit and is much more likely to have its cutting angle portion broken. The knife, for this reason, must not be tempered too hard.

To open the anterior cells, those about the infundibulum and the floor of the frontal sinus, the knife is pushed up into the infundibulum,

sagittally under the anterior third of the middle turbinate as far as the uncinate process, as high as the cribriform plate, with its cutting edge facing forward. It is then rotated inward and drawn forward and downward (Fig. 11). This cuts open the foremost and uppermost wall of the

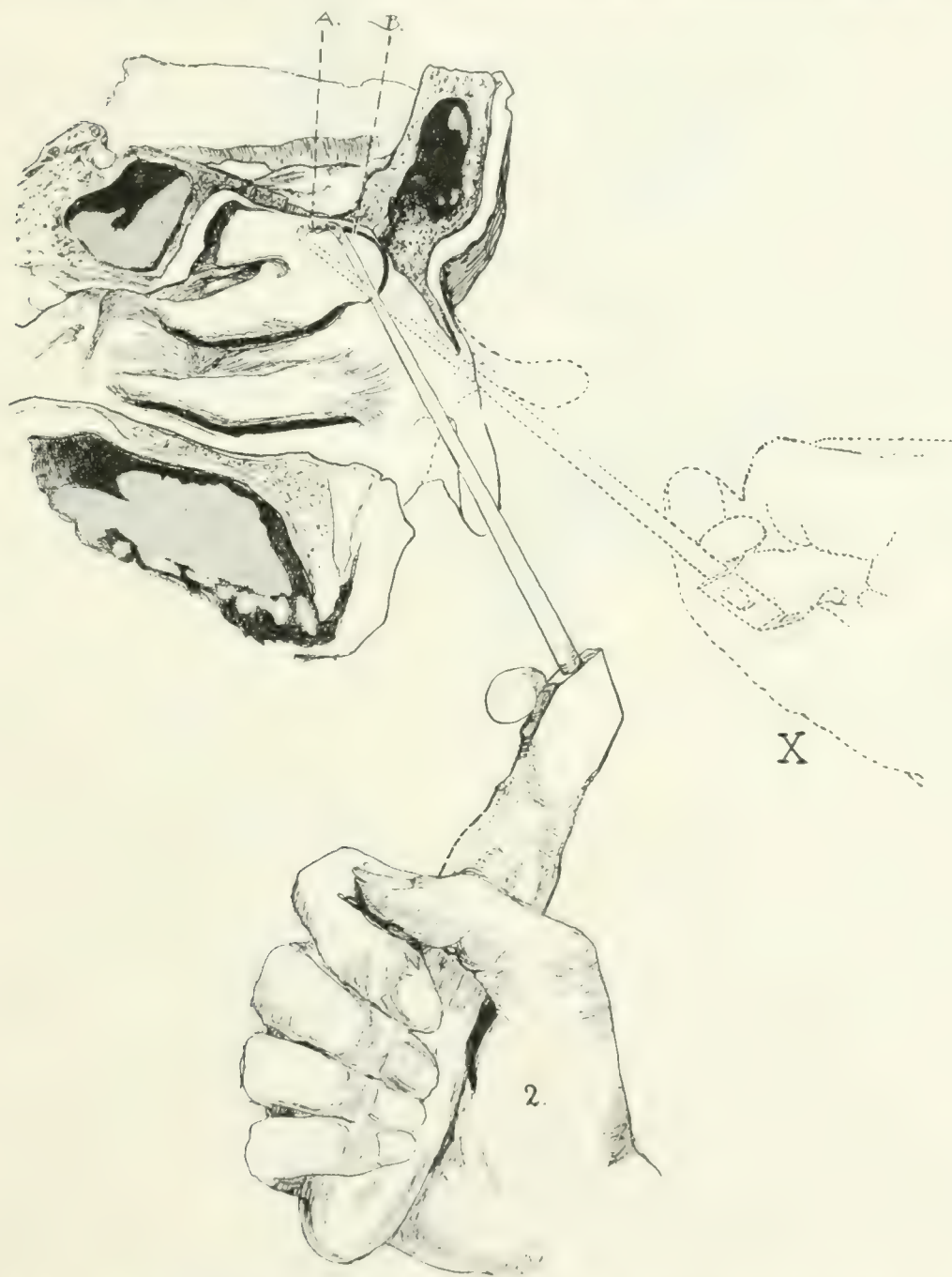


FIG. 12.—Shows the angle knife introduced between the septum and middle turbinate. It has passed 1 cm. back to the first cut along the cribriform plate. The dotted line X shows it to have been rotated outward until its cutting edges point 30 degrees above the horizontal. The tip of the nose has, at the same time, been forcibly elevated. The heavy dotted line a-b shows the line of cut.

ethmoid capsule, and opens up the outlet of the frontal sinus. If this latter is insufficient the knife is reintroduced in the hiatus semilunaris with the cutting edge forward and downward in the uppermost limit. A down-pull now removes the uncinate process, and the knife may be

engaged in the floor of the frontal sinus and a fair opening secured, which may then be enlarged by any means thought desirable. During these



FIG. 13. Shows the knife introduced sagittally under (lateral to) the middle turbinate for the purpose of cutting into the capsule of the ethmoid. The dotted lines 1-2-3 show the successive cuts from above downward. These cuts may be readily made to enter the orbit by inclining the cutting edges 30 degrees outward. In the conservative employment of this technic, this employment of the knife may be omitted.

manipulations the cutting is always away from danger. To complete the removal of the anterior ethmoidal cells the knife is introduced along

the cribriform plate with its smooth elbow uppermost, and rotated until its cutting edge points outward, 1 cm. back of the first incision. The pull is forward, the tip of the nose being forcibly elevated in order to obtain the proper direction. Second and third cuts are made, each 1 cm. back of the one preceding, so that the whole anterior portion of the ethmoid capsule is free. It is now pushed downward into the nose and removed with a snare. If desired the orbit may be opened by the same procedure for the intranasal drainage of orbit phlegmons.

To attack the sphenoid and postethmoid cells, if the septum is deviated toward that side the long-bladed speculum is used to forcibly crush the septum into the opposite naris, and retain it there until the accomplishment of the operation. The knife is now introduced along the cribriform plate as before until the anterior face of the sphenoid is reached at its uppermost limit. With a little force the knife enters the sphenoid cavity, is turned inward and made to cut inward and downward along the septal wall of the sphenoid until dense bone near the floor is encountered. Reintroduced and turned 30 degrees outward a similar external cut is made which usually includes a considerable part of the wall separating the postethmoidal from the sphenoidal cell, and the whole face of the sphenoid may now be removed with the Knight forceps, long model. Often the floor of the sphenoid may now also be removed with this forceps.

Sluder claims that this very rapid method, for he has done all this in two minutes, may be made as conservative or as radical as the case may require. Absolute safety in trained hands is assured, and cells may thus be reached that would not be touched by any other technic. Drainage of all, including the frontal, is assured.

Hay Fever. Many cases of hyperesthetic rhinitis, formerly thought to be of other than pollen origin, have been proved by W. Scheppegrell³⁹ to be in reality due to certain plants which pollinate at unusual times of the year, but this would probably apply only to the Southern States, since in the North, during the winter months, all vegetation is at a standstill. The tests were mostly made in the vicinity of New Orleans, and with the "atmospheric-pollen plates" described last year. Certainly the results of these tests are surprising, since, for instance, a form of hay fever, hitherto unrecognized, was found to exist in February and to be due to the pollen of the usual meadow grass, which in higher latitudes does not bloom until June. Also, hay fever in December and January is due to the false wormwood, a perennial bloomer, while the mountain cedar accounts for a certain number of midwinter cases. These diagnoses were all controlled by biological tests. Dust plays an important part in the production of hay fever in two ways: by irritating the sensitive mucous membrane, and by usually containing large amounts of atmospheric pollen. The plates, carried on railway trains and in automobiles, proved this, and, furthermore, a rain of long enough duration to allow the patient to recover from the effects of the pollen already inhaled gives relief to the pollen subject. Wet pollen is not irritative

³⁹ Laryngoscope, August, 1917.

after it has again dried, as the toxic properties are removed by submersion in large amounts of water.

Scheppegrell summarizes as follows:

1. Hay fever is the most important and common form of hyperesthetic rhinitis.
2. Many cases of hyperesthetic rhinitis of unknown origin are really due to atmospheric pollens and are therefore true hay fever.
3. The irritating effects of dust are often due to the presence of hay-fever pollens.
4. In hay fever, there is both a direct (local) and indirect (constitutional) effect of the pollens.
5. The recognition of the pollens which cause hay fever is important from both a therapeutic and prophylactic stand-point.
6. In cases in which an attack of hay fever would be a serious complication the patient may be protected by the solvent action of water on the atmospheric pollens.

Those who have done any pollen desensitization work know that the ordinary watery extracts are unstable and rapidly deteriorate, losing their potency, according to some workers, in a few weeks after preparation. Clock⁴⁰ has been able to prepare stable pollen antigens by extracting the pollen in 66 $\frac{2}{3}$ per cent. glycerol and 33 $\frac{1}{3}$ per cent. saturated sodium chloride solution. This remains stable and potent, and also sterile. He makes a "combined" extract by using equal parts by weight of the pollens of timothy, red top, June grass, orchard grass, rye, sorrel, dock, daisy, maize, ragweed and golden rod, as these are the accepted causes of the great majority of both vernal and autumnal hay fever.

Cooke, Flood and Coca⁴¹ have made careful laboratory studies into the question of the hypersensitiveness of certain individuals to pollen and to the question of the toxic qualities of the pollen itself. Assembling the available facts, clinical and experimental, relating to hay fever, they formulate the following conception of that form, and indeed of all forms, of human sensitization:

1. Hay fever is the clinical symptomatic expression of local hypersensitiveness. The active pollen substances are not toxins.
2. The hypersensitiveness is established spontaneously and never by immunological process. This has been shown in two ways: (a) by the observation of Dunbar, confirmed by Cooke, that individuals may be sensitive to pollens of plants that are indigenous in foreign countries and with which they have never come in contact, and (b) by the observation by Cooke that individuals who are naturally sensitive to one protein only cannot be artificially sensitized to another protein, either animal or vegetable.
3. The sensitization is not directly inherited, although the tendency to spontaneous sensitization is inherited as a dominant character.
4. The antibody-like substances of human sensitization are not demonstrable in the blood of sensitive persons by any of the immunity

⁴⁰ Journal of Infectious Diseases, October, 1917.

⁴¹ Journal of Immunology, February, 1917.

reactions. They are present in the cells of the sensitive tissues. They cannot be increased artificially by the usual process of immunization.

5. The mechanism of the alleviating effect of specific, *i. e.*, vaccine therapy is the same as that of desensitization in experimental anaphylaxis. The freedom from symptoms lasts as long as the respective "antigenic" substances remain in combination with the antibody-like substances in the tissues.

General Anesthesia. Wishart⁴² protests against the growing tendency to do nose and throat operations under ether, and calls attention to the danger of using adrenalin when a general anesthetic is used. In addition, it is a well-known fact that adrenalin will have little effect as an astringent in the nose of an etherized person, although if applied prior to the administration of ether its action remains positive.

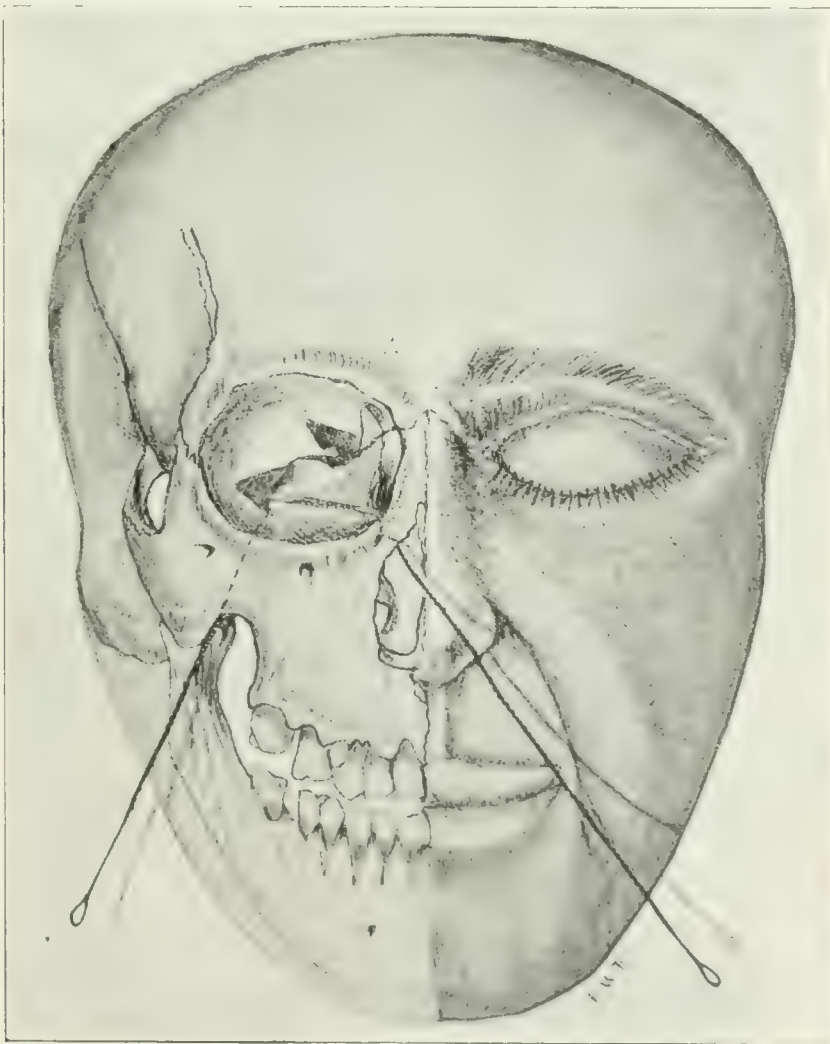


FIG. 14.—The approximate line of the saw cut.

McCarty and Davis⁴³ have investigated the warm ether-vapor idea and find that it does not hold. They found that the amount of heat taken from the body to warm cold ether vapor was so small that it was a negligible factor in lowering body temperature and in producing shock;

⁴² Canadian Practitioner and Review, January, 1916.

⁴³ Annals of Surgery, March, 1916.

that the warming of the vapor administered is accomplished in the mouth, pharynx and trachea, so that the vapor reaches the alveoli at body temperature; that with warm ether no less amount is required than when it is cold; that cold ether is not more irritating to mucous membranes than warm ether; and that no more mucus or saliva are secreted with the cold than with the warm.

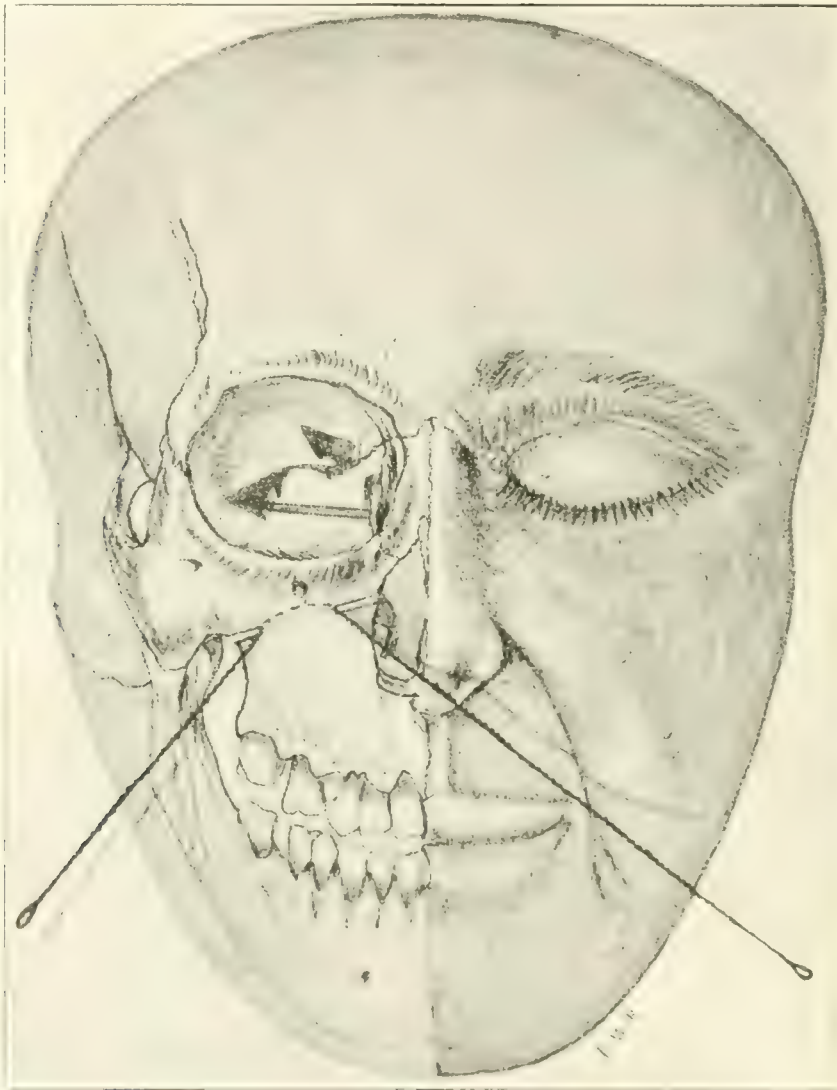


FIG. 15.—The saw cut almost complete.

Resection of the Superior Maxilla Retaining the Floor of the Orbit. While the accepted form of operation for excision of the superior maxilla does not leave nearly as much deformity as might be expected, it is still an advantage to retain the floor of the orbit in those cases in which the malignant disease has not invaded this structure. The operation performed by Van Hook⁴⁴ is begun and carried out in the usual way until the point of separation from the orbit is reached. At this juncture the contents of the orbit, including the periosteum, are held up with a spatulous retractor. A grooved director is bent into the form of a hook and passed into the orbital cavity until the sphenomaxillary

⁴⁴ Journal of American Medical Association, October 6, 1917.

fissure is found and the point passed out into the zygomatic fossa, where a silk loop is attached, to which, in turn, is attached a Gigli saw. The same director is now passed toward the inner side of the orbit, and caused to perforate the thin bone back of the lacrimal groove, into the nose, where it can be made to emerge from the bony nasal cavity. Here it is again threaded and withdrawn, the silk attached in the orbit and the Gigli saw drawn through into the nose, crossing the orbit above. This cut of the saw, from the sphenomaxillary fissure across the floor of the orbit and through the lacrimal groove into the nose detaches the upper portion of the maxilla, but leaves the floor of the orbit intact except for the line of the cut. It thus accomplishes at once three of the classical steps of the operation, dividing the malar bone, separating the superior maxilla from its orbital connection and transecting the nasal process of the upper jaw bone.

THROAT AND LARYNX.

Asthma. As I stated last year, asthma is a fit study for the laryngologist, formerly because it was considered due to irritation caused by malformations and abnormalities of the nose and latterly because it is believed by many to be due to a sensitization to certain foreign antigens, the bacterial ones at least gaining access to the subject through primary invasion of the nose and throat. A still broader reason is that the laryngologist, since the introduction of air-passage endoscopy, now lays claim to many parts of the field formerly in the care of the internist alone. Much good research work has been done, proving by dermal, complement-fixation and agglutination tests that the entrance of foreign substances into the system is the cause of bronchial asthma in a large proportion of cases.

The work of Chandler Walker⁴⁵ at the Peter Bent Brigham Hospital is of peculiar interest as a statistical study of 150 cases that have been worked out to a conclusion. The study has been made because of the close relationship between the symptoms of bronchial asthma in man and those of anaphylaxis in animals and the part played by protein sensitization as a cause of bronchial asthma. For instance, if a bronchial asthmatic who is sensitive to some protein be injected subcutaneously with a small amount of this protein, he will shortly have an attack of bronchial asthma, with difficulty at first in expiring, and only later, as the lungs became distended, in inspiring also. The injection of epinephrin at once relieves the attack and the lungs expand properly. Thus, attacks of bronchial asthma and anaphylaxis are similar in that both may be caused by proteins, and the symptoms are similar in that there is labored respiration. Pathologically the two conditions are alike, in that there is distention of the lungs, and, furthermore, in animals there is stenosis of the bronchioles; in the human body there is evidence of this from the carbon dioxide content of the alveolar air. And, lastly, both conditions are relieved by epinephrin.

The author uses the cutaneous test to demonstrate the protein causing

⁴⁵ Journal of American Medical Association, August 4, 1917.

the asthma, making a number of small cuts in the skin, without drawing blood, placing on each the protein substance to be tested and adding a drop of tenth-normal sodium hydroxide solution to dissolve it and permit rapid absorption. This is washed off in half an hour and the size of the reaction, if any, noted, and compared with a control. The smallest reaction must measure at least 0.5 cm. in diameter to be called positive.

Of 150 asthmatics so tested 83 were found sensitive to some protein as follows: Horse, 20 per cent.; wheat, *Staphylococcus aureus* and early pollens, 15 per cent. each; late pollens, 10 per cent.; cat, 5 per cent.; *Staphylococcus albus*, 3 per cent.; miscellaneous proteins, 7 per cent.; in the remaining 10 per cent. there was multiple sensitization. In the miscellaneous group one patient was sensitive to casein, one to egg, two to chicken meat, one to feathers and one to flax seed. Only a small portion of those patients sensitive to horse dandruff were sensitive to horse serum, so that the danger of injecting an asthmatic with moderate amounts of curative sera is limited to rare cases. This holds true with other proteins from the same animal; for example, in beef animals the patient may be sensitized to all or one only of the following: meat, milk, serum or hair; of the fowl: feathers, meat, egg; sheep: wool, meat, serum, etc. The skin reaction is a specific test in separating these more or less closely related proteins.

Of the non-sensitive group in the 150 cases studied, it is considered that possibly an intradermal test might show sensitization to some of the bacterial proteins other than the common ones used in the above tests.

The asthmatics are divided then into two groups, the sensitive and non-sensitive, and each has some other curious and interesting features. No patient that had onset of asthma after the fortieth year gave a positive skin test and one-half of the sensitive patients began to have asthma previous to the age of twenty. On the other hand, 40 per cent. of the non-sensitive patients had onset of asthma after the fortieth year, and only 15 per cent. had onset of asthma previous to the age of twenty. Only 1 per cent. of sensitive patients had cardiorenal disease, whereas 20 per cent. of the non-sensitive patients had this complication. Chronic bronchitis was a complication in only a small number of the sensitive patients, but it was present in nearly all of the non-sensitive group. To sum up these statements: The patient that has onset of asthma *early* in life is usually sensitive to some protein, does not usually have chronic bronchitis and rarely cardiorenal trouble. The patient with onset of asthma *after* the age of forty is *not* sensitive to proteins, has chronic bronchitis often, and frequently cardiorenal disease.

Brown⁴⁶ believes that whether we accept the anaphylactic theory of the causation of asthma by the absorption of foreign proteins or the older reflex theory the nose is the seat of the trouble, and especially the ethmoid labyrinth. In either case, however, there must be some other underlying etiological factor, because the same conditions present themselves in the naris many times while only a few develop asthma. The reflex theory implies that these attacks are brought about by an

⁴⁶ *Annals of Otology, Rhinology and Laryngology*, June, 1917.

irritant in the naris or some other part of the body, causing a reflex stimulation of the smooth muscle of the smaller bronchi. In the nose this might come from a contact of the ethmoid with the septum or the altered secretion. Twenty-seven cases of asthma are reported, with the ages ranging from four to sixty-two. All were severe types, and in all there was demonstrable some involvement of the ethmoids. This was a constant factor, though other pathological conditions frequently existed. Only 5 of the cases had ethmoid suppuration and it is believed that the probable reason that these cases do not develop asthma more frequently is that suppuration of any length of time will cause a degeneration of the normal mucous membrane and the nerve terminals. Brown believes that there must be some underlying factor that produces the asthma, and he designates this the neurotic state of the individual, which is not altogether satisfactory. He thinks some attacks of asthma are purely reflex. The marked association of asthma and ethmoiditis has long been recognized by rhinologists, and often great improvement follows removal of pathological lesions. In the series reported, there were 6 complete recoveries, 12 decidedly improved, 7 but slightly improved, and 2 not improved at all, by complete operation.

Walker, quoted above, has followed the desensitization line of treatment exclusively. In the non-sensitive group this was disappointing. A number of cases were relieved by vaccines of a diphtheroid organism, used because it was the predominating one in the sputum, and whether stock or autogenous, seemed to make but little difference. In those patients whose sera agglutinated strains of the *Staphylococcus aureus*, stock vaccines of this organism gave very satisfactory results, though the relief only continued for a few months after cessation of treatment. A good prognosis can be given for those included in the sensitive group. If the sensitization is to a food protein, omission of that food from the diet is followed by relief from asthma unless there is a marked chronic bronchitis, in which case vaccines made from the organisms in the sputum are greatly beneficial. Those patients who are sensitive to bacterial proteins are successfully treated with stock vaccines of the particular organism they are sensitive to. Overdosing, especially at first, will produce an asthmatic attack. Those who are sensitive to horse dandruff and cat hair can be desensitized by the use of these proteins, but horse asthmatics are not relieved by horse serum, unless sensitive to the latter also. In the latter case, desensitization is quite feasible. There is, therefore, a specificity among proteins in the cause and treatment of bronchial asthma. "Colds" often precipitate asthmatic attacks, and there seems to be two types of "colds," one of which is anaphylactic and may be controlled by proper treatment with proteins, while the other is bacterial and frequently relieved or prevented by vaccines. If the asthma is caused by bacterial proteins the foci containing them should be removed, whether in the tonsils, the teeth, the sinuses or elsewhere.

Secord⁴⁷ reports bronchial asthmatics cured up to a period of two years by autogenous vaccine made from the sputum. Frequently these

⁴⁷ American Journal of the Medical Sciences, June, 1917.

organisms are the *Streptococcus viridans*, or the *Streptococcus hemolyticus*, and the dosage at the start for an adult is 100,000,000, feeling his way cautiously until the dose that will produce local reaction is determined and then aiming to produce local, but avoiding general, reaction at each dose. Very often the asthma has ceased after the first injection, and improvement follows in nearly all cases.

Auld⁴⁸ advocates, in certain selected cases, an immunization treatment that in his hands has proved of value. The patients selected are those who have no other disease and not enough chronic bronchitis to cause dyspnea between the asthmatic attacks. One-third gram of peptone dissolved in 5 c.c. distilled water at body temperature is injected three or four days the first week. This is increased to $\frac{2}{3}$ gram the second week and 1 gram the third week, which is often sufficient, although some cases require treatment at the same dose for two or three weeks longer. There is no apparent constitutional reaction, and often the benefit is great.

Intubation. A method of retaining the intubation tube in the throats of those children in whom it is constantly being expelled has been described by Polverini and advocated by Bernasconi.⁴⁹ The technic consists in using an O'Dwyer tube with two small holes drilled at the front instead of the one usually found. Introducing the finger into the throat, as for ordinary intubation, an ordinary long and stout needle, carrying a long, strong silk thread, is inserted into the neck exactly on the median line and is passed through the thyroid membrane at the junction of the lower and middle thirds. The point of the entering needle is felt by the index finger in the throat and is guided upward until it can be seized and drawn out of the mouth, the ends of the thread projecting below. The upper end is passed through the two holes in the intubation tube and tied in a double knot about 60 cm. below the upper free ends of the thread. Intubation is now done and the lower thread ends drawn tight and tied over a roll of gauze on the front of the neck. This is protected from infection by a gauze dressing. The tube can readily be withdrawn by pulling on the upper ends, although, if it is likely to be worn for some time, it is better to cut them off. This method is comparatively simple and of value when the alternative is tracheotomy. It is always reliable and has been in use for over ten years by the author of this method. There are no bloodvessels or nerves in this region to be injured and the needle passes readily through the aponeurosis, the thyroid membrane, and adipose tissue.

The Larynx. Chevalier Jackson,⁵⁰ as usual, has some new ideas on laryngeal and endoscopic procedures, and his latest he terms the *orthopedic treatment of laryngeal stenosis*, a pathological condition that at one time or another has baffled nearly every laryngologist. The method has been in use by the author for years, and consists in using a small tracheal tube in order that air may be able to leak past into and through the larynx, for the patient must be tested as to his ability to breathe through

⁴⁸ British Medical Journal, May, 1917.

⁴⁹ Rev. méd. de la Suisse romande, March, 1917, and Journal of the American Medical Association, February 10, 1917.

⁵⁰ Journal of Laryngology, Rhinology and Otology, February, 1917.

the mouth and must have his confidence established before the tracheal wound is allowed to close. A rubber cork with a slot cut in it is inserted into the tracheal cannula so that it diminishes but does not altogether obstruct cannular breathing. The cork is gradually pushed in tighter until no air at all is passing through the cannular outlet, and a solid cork can be worn while the patient is awake. If it can also be used with the patient asleep and without any indrawing at the gutteral fossa, at the epigastrium or around the clavicles, the cannula may be removed permanently. By the orthopedic action of the method is meant that in those cases in which there is more or less fixation of the crico-arytenoid joint due to arthritis, perichondritis or cicatricial adhesions, the enforced effort of compelling the patient to breathe through the larynx forces the maximum possible arytenoid movement on the larynx, which tends to limber up the stiffened joint and develop atrophied muscles. This pull will, in time, enlarge a cicatricially contracted glottis, and the effect is often marked in purely paralytic conditions, especially if undertaken soon after the trouble starts. Great success is attainable in children in whom the tendency of natural growth and development is of great assistance; but a nurse especially qualified in tracheal work is a *sine qua non*, because the greatest good judgment is required in regulating the air supplied by the slotted cork, especially during the night.

ENDOSCOPY. Lynch⁵¹ advocates the use of suspension in all cases of bronchoscopy and esophagoscopy in children, as it makes the introduction and manipulation of the tubes a much simpler matter; and besides, often the suspension spatula itself will be sufficient without the passage of a tube of any kind. He cites several such instances in which no tube was passed. In one a watermelon seed was coughed out as soon as the child was suspended and the cords separated by elevators, and a mass of insufflated peanuts in the trachea was removed by forceps and suction alone. Lynch believes, with Jackson, that no general anesthesia should be given in children, but he paints the larynx with cocaine after the child is suspended. Infants and young children are ideal subjects for suspension because of the undeveloped musculature, their flexible necks and the short distance of the larynx from the teeth. The greatest percentage of foreign bodies occur in children and also the greatest number of postoperative reactions and edemas due to traumatism in passing the endoscopes.

The method of using combined suspension and bronchoscopy is slightly different in several details from that used when intralaryngeal surgery is needed and the anterior commissure must be inspected. For bronchoscopic purposes the head of the table is not dropped and the patient's head is flexed rather than extended. Just sufficient extension by moving the horizontal crane outward is made to bring into view the posterior two-thirds of the larynx and the neck is straightened by the elevation of the travelling crane, with the patient's head still on the table. Either the spatula or the end of the tube may be used to pick up the epiglottis and the way is clear to pass the tube either into the trachea or esophagus with the greatest ease, by direct vision, and, with the use of retraction,

⁵¹ Laryngoscope, July, 1917.

to separate the cords, without its coming into contact with the larynx at all until the end is safely through and there is no further danger of laryngeal injury. By moving the crane and the head the tube may now be passed into any bronchus at will, and with deliberation and accuracy. During all this procedure the child, firmly wrapped in a sheet, is much more immovable, once it is in suspension, than when held in the ordinary manner. Lynch emphasizes the point that there is no hesitation about withdrawing the tube owing to the ease with which reintroduction can be accomplished, and, if tracheotomy should have to be done, the patient is in an ideal position.

The use of endoscopy in *tracheobronchial diphtheria* has been pointed out by Lynch⁵² on several occasions, who believes that diphtheria is primary in the trachea or bronchi in a much larger proportion of cases than is supposed, the membrane spreading downward or upward, but often without invasion of the larynx or fauces. These cases always give negative cultures because the true seat of the trouble is not cultured at all and are frequently diagnosed bronchial pneumonia, although the clinical picture, if understood, is a distinct one. This form of diphtheria has a very insidious onset, the first symptoms noted being frequently the dyspnea caused by the encroachment of the membrane on the patient's breathing space. Also, these cases, without bronchoscopic treatment, have a very high mortality, as intubation, even with long tubes, and tracheotomy are too high to relieve the obstruction. Furthermore, if tracheotomy is done and the membrane removed through the tracheotomy wound, it always reforms and the patient dies. By bronchoscopic removal of these obstructing casts the author has been able to establish a recovery rate of 64.6 per cent., even including those cases which were *in extremis* when brought to the hospital. In these cases the voice is never lost and there is only an occasional cough and slight stridor, much resembling an ordinary cold. Late in the course of the disease there is a ballooning of the chest due to difficult expiration, giving an asthmatic type of breathing.

Bronchoscopic examination, without anesthesia, local or general, is easily borne, without shock, even in cases of pneumonia. Mechanical removal of the membrane through the bronchoscope is not difficult if the case is recognized fairly early in the disease, and with the administration of appropriate doses of antitoxin gives a very favorable prognosis. There is only a small amount of bleeding compared with that obtained if the membrane is forcibly stripped from the tonsils and larynx. Suction is employed for the purpose through a small suction tube and not more than a vacuum of five inches used. More vacuum will cause increased bleeding and will injure the mucous membrane wherever the tip of the tube comes in contact with it. After the removal of the diphtheritic membrane the tracheobronchi are swabbed or sprayed locally with antitoxin in order to control the hemorrhage and to prevent, in part, reformation of membrane. A long intubation tube is also inserted to combat the latter eventuality and any edema of the glottis that may arise.

⁵² Transactions of American Laryngological, Rhinological and Otological Society, 1916.

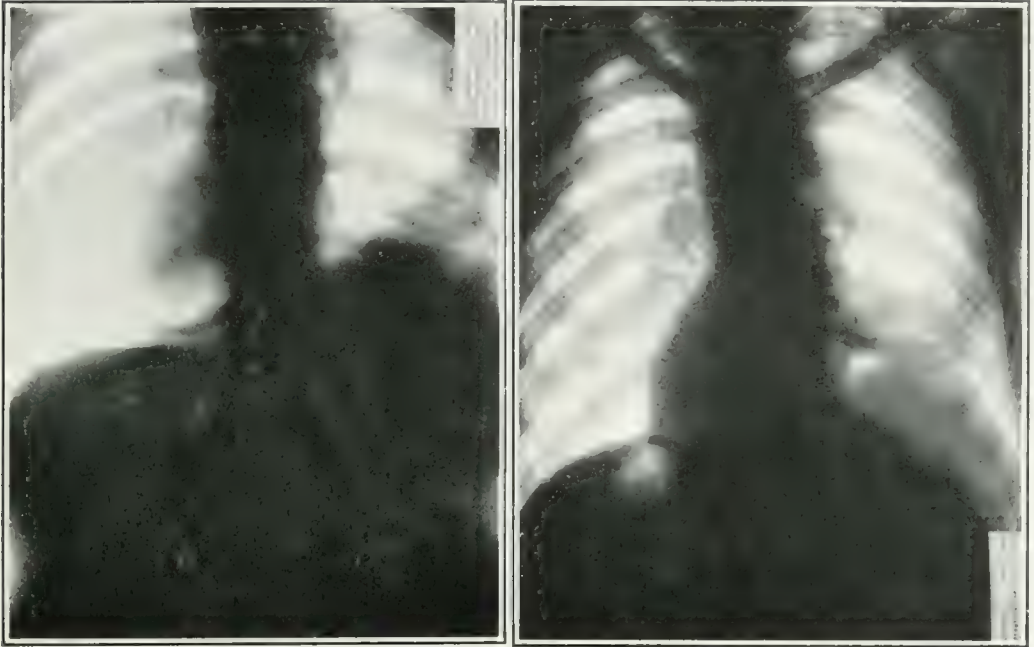


FIG. 16.—Roentgenogram showing (on left) opacity of lower lobe of right lung, due to obstruction of right bronchus by tumor shown in Fig. 17. The right-hand side of illustration shows roentgenogram taken after peroral bronchoscopic removal of tumor.

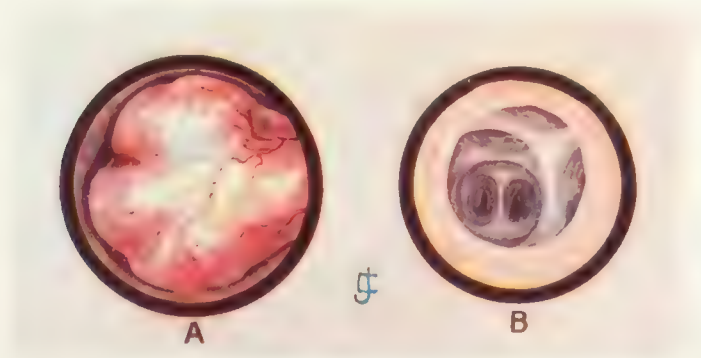


FIG. 17.—Endobronchial obstructing endothelial tumor in a man, aged thirty-five years, who complained of coughing, wheezing, and "a sensation as of a ball valve shutting off his breath, sometimes on inspiration and at other times on expiration." *B*, bronchoscopic view down right main bronchus. *A*, tumor presenting itself in its self-made bronchial enlargement, when the bronchoscopic tube-mouth reached the location at which the view *B* should appear. Tumor removed with forceps through a bronchoscope passed through the mouth. Patient free from symptoms at end of three weeks and remained perfectly well a year and a half later.

We are all familiar with those curious cases of chronic diphtheritic membranous conditions that sometimes are found in the nose, and I well remember seeing such a one in the service of Professor A. W. Watson at the Philadelphia Polyclinic, where the membrane persisted for months, giving all the time positive cultures. Skillern⁵³ reports a case of chronic tracheobronchial membrane in a child who was brought in with a history of having "swallowed" a glass bead, of coughing and suffocation spells at night for several months. There was a history of faucial diphtheria nine months previously. Bronchoscopic examination showed a membranous mass at the lower lobe bifurcation on the right side, which left bleeding areas on removal. All of this was removed at two operations a few days apart, and the membrane was identical with that of diphtheria and showed almost pure cultures of Klebs-Löffler bacilli, which, however, were not fatal for guinea-pigs.

As illustrating the progress that has been made in bronchoscopy a case report by Jackson⁵⁴ of *endoscopic removal of an endothelioma of the bronchus* is of great interest. The patient, a male, aged thirty-five years, had had for five years wheezing and a feeling of compression in the right chest and some dyspnea. There had been some hemoptysis, and physical examination pointed to some obstruction of the right main bronchus. Bronchoscopy showed a smooth, round tumor almost filling the dilated right bronchus and attached to the right wall of the latter just above the orifice of the middle-lobe bronchus. As it had the appearance of a benign fibroma it was immediately excised with biting forceps; there was little bleeding and but slight rise in temperature, and nearly all symptoms had disappeared by the end of a few weeks. In spite of the microscopic diagnosis of endothelioma the patient was in splendid health one and a half years afterward, with no signs of recurrence. This case shows us the possibilities of diagnostic as well as operative bronchoscopy, and the author concludes that:

1. Diagnostic bronchoscopy is indicated in cases of monolateral "asthma," bronchitis, bronchial obstruction, and in cases of tuberculosis where persistent search fails to show tubercle bacilli.

2. Peroral bronchoscopic removal of an endobronchial tumor is feasible under local anesthesia.

3. General anesthesia might have permitted clotting of blood in the lower bronchi before bechic expulsion, involving septic risk.

4. Peroral bronchoscopic removal may be justifiable in a malignant endobronchial growth if small, circumscribed and not ulcerated.

5. As this is the only recorded case of apparent cure of an endothelial endobronchial tumor by peroral bronchoscopy, and only the second endoscopic removal of any form of malignant growth from a bronchus, it would be unwise to make too many or too sweeping deductions.

Strictures, Webs and Pouches of the Esophagus. Guisez⁵⁵ reports a technic for making continuous pressure on a stricture of the esophagus and yet allow the patient to be fed. The apparatus consists of a rubber drainage tube with the upper and lower ends larger than the diameter

⁵³ Laryngoscope, February, 1917.

⁵⁴ American Journal of the Medical Sciences, March, 1917.

⁵⁵ Rev. de laryngol., d'otol., et de rhinol., June 15, 1917.

of the stricture, so that when once in place it cannot be swallowed or expelled. The tube is closed at the lower end, which is slightly pointed, but has lateral openings near the tip to permit the passage of food. It is constructed much on the principle of Freer's self-retaining frontal sinus tubes. Emplacement is effected by passing an obturator into the end of the tube, the upper end of which is steadied by a silk cord, and the tube put upon the stretch, which temporarily smoothes out the lower enlargement. This is then introduced below the stricture, when the removal of the obturator allows the lower enlargement to expand and the tube is fastened in position. The silk cord is now withdrawn by pulling on one end. This mechanism is allowed to remain in for a considerable length of time, and the continuous pressure exerted thus upon the stricture results in absorption of the fibrous tissue. It may be withdrawn by the use of the esophagoscope and replaced by a larger one if necessary. Needless to say that very small strictures must first be dilated by ordinary bouginage until of sufficient width to allow the passage of a tube of this character.

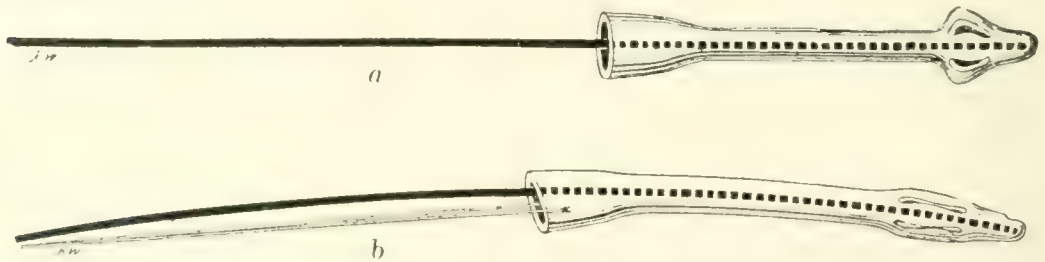


FIG. 18.—Intubation tube. *a*, before tension on the cord; *b*, after tension on the cord.

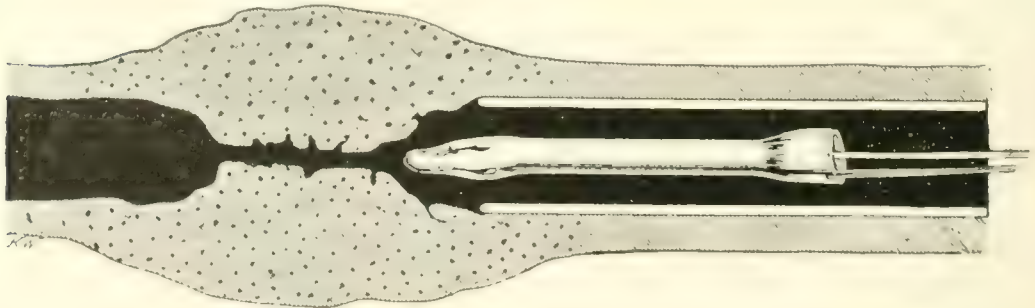


FIG. 19.—The intubation tube, about to enter the stricture, stretched on the obturator.

Oppikofer⁵⁶ confirms Wagener's assertion that the finding of frothy mucus in the fossa on the side of the larynx, external to the aryepiglottic fold, is presumptive evidence of a *diverticulum in the esophagus*, just below the pharynx, but also found that it was present in 19 out of 200 healthy persons examined as well as in any acute or chronic inflammatory affection of the esophagus, cancer of the larynx, etc. In these cases, however, it was not constant, and the pyriform sinus was never completely filled, as would be the case when a diverticulum was present. Mosher⁵⁷ states that diverticula and pouches at the upper end of the esophagus, while not common, are not exceedingly rare. As described by Jackson,

⁵⁶ Correspondenz-Blatt für schweizer Aerzte, September, 1917.

⁵⁷ Surgery, Gynecology and Obstetrics, August, 1917.

the lower ones are formed by cicatricial contraction, which pulls one side of the esophagus out of its normal position, thereby enlarging it. These usually give very few symptoms and remain unrecognized. The upper ones may be very small, holding but 1 or 2 c.c., or they may be very large dilatations, bulging out the side of the neck. They are seldom seen before middle age, and may extend to the level of the lower border of the clavicle. Once a pouch is started, the pressure and retention of food continually make it enlarge, but the causation of the starting itself is in doubt. The symptoms are gradually increasing difficulty in swallowing, until a liquid and minced diet is the only one that can be taken. Sooner or later much of this undigested food is regurgitated and there is a sound of gurgling. The pouch tends to empty itself at night, causing coughing and strangling. There is no pain. Mosher notes the frothy, dirty fluid in the pyriform sinus described by Wagener and Oppikofer, and says it can best be demonstrated by pressure on the sides of the larynx. The modern diagnosis is made by the fluoroscope, the *x*-ray plate after swallowing bismuth, and the examination of the upper esophagus with the well-known Mosher ballooning esophagoscope. The tube is passed into the pouch, preferably under morphine, atropine and ether anesthesia and the pouch emptied by suction. It is then studied and the small opening into the esophagus found by the use of the ballooning attachment. This is always placed anteriorly, and is small and round. This opening may have to be dilated before it is large enough to admit the passage of the tube.

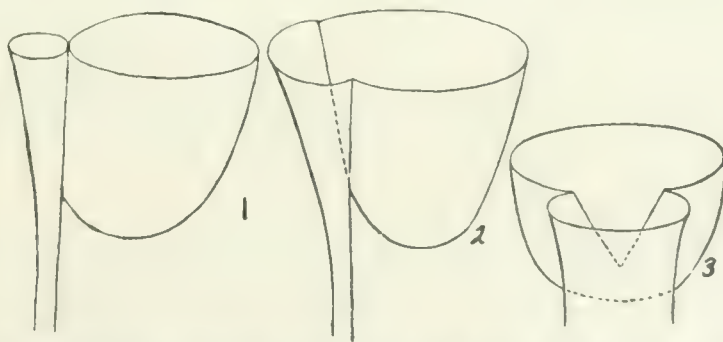


FIG. 20.—Diagrammatic drawing to show the result of cutting the common wall between an esophageal pouch and the esophagus. 1, an esophageal pouch with its large lumen and the esophagus with the small opening which the esophagus has when associated with a pouch. 2, the effect of cutting two-thirds of the common wall between the pouch and the esophagus (seen from the side). 3, the effect of cutting the common wall between the esophageal pouch and the esophagus (seen from the front).

The older operations for the relief of this condition consisted in the dilatation of the opening and training the patient in the technic of keeping it open; or in the excision of the sac by external operation. Mosher suggests, and has practised successfully, an internal operation which is about to be described and which has given entire relief. It consists in cutting away the common wall between the pouch and the esophagus, leaving therefore a dilated esophagus without any pouch for the accumulation of food or any obstruction to its passage. The operation is done endoscopically under ether with the author's ballooning esophagoscope. The opening out of the pouch is located and a scissors punch passed

through the operating window of the scope. The common wall is now so located that it bisects the transverse diameter of the esophagoscope and the first cut is made in the center of it, about a quarter of an inch long. There is a little bleeding which is cleared by suction. These cuts are continued, gradually biting out the common wall, until a point is reached an eighth of an inch from the floor of the pouch, the slight ridge being left in order to avoid opening the mediastinum. After-care consists in abstinence from food for twenty-four hours and 20-grain doses of bismuth subnitrate four times during this period. The patient's heels are kept higher than his head and he is fed by rectum for two days. At the end of a week a No. 48 English bougie is passed every second day and the patient taught to do it for himself for a month or so. In the few cases in which this operation has been used, clinical symptoms were all relieved by it, but the fate of the remains of the pouch has yet to be determined.

The Tonsils. Last year PROGRESSIVE MEDICINE commented on the development and perfection, by Thomas R. French, of the technic of transillumination of the tonsil by means of the tonsilloscope as a means of determining the question of pathology of this organ *in situ* in the living subject and as affecting the question of removal. At that time the colored chart showing French's classification was not available. This chart is now presented, with the statement made by Dr. French to the writer that he is more than ever convinced, after an additional year's experience with the method, that it is of great value.

The Tonsil Code. The reproductions of water-color illustrations shown represent transilluminated tonsils and anterior faucial pillars *in situ*, as seen in the tonsil microscope. The tonsils show the conditions which present in the microscopic field in the various classes and also, approximately, their colors and varying shades of colors in contrast to the fixed shade of color of the anterior pillars.

The unvarying shade of red of the anterior pillars should be used as a control to compare with the amber or the varying shades of red in the different classes of tonsils. Generally speaking, the greater the contrast in color or in the shades of the same color between the tonsil and the anterior pillar the less the disease in the tonsil. The shade of red of the tonsil in Class 6, which is the most diseased class, is always the same as that of the anterior pillar.

Class 1. The tonsil of health.

Class 2. Borderline conditions.

Class 3. Small chronic abscesses near the surface.

Class 4. Hyperemic plumes indicating the presence of deeply located and irritating foci of detritus or pus in limited areas of the tonsil.

Class 5. Considerable general disease. Visible foci at various depths in the tonsil. Also collections of detritus caught between the anterior pillar and the tonsil.

Class 6. Extensive general disease. The tonsil and the anterior pillar are the same shade of red. Dark perpendicular lines indicating congestion of the mucous membrane usually appear in the anterior pillars in this class.

The colors of the figures in the plate when viewed by daylight are somewhat deceptive. By artificial light, however, they approach quite closely those of the living tissues.

As usual, many articles on the tonsil have appeared during the past year, mostly in American current literature, and the various questions under discussion seem to be no nearer a solution than heretofore. Nothing of importance in regard to diagnosis has been added, and as to the questions of when and how to remove tonsils, there are various opinions expressed, as well as to the dangers, complications and sequelæ.

While the tonsilloscope of French may give to the eye of the initiated a true picture of the amount of gross pathological change in a tonsil, Mitchell⁵⁸ has studied the question of PRIMARY TUBERCULOSIS OF THE FAUCIAL TONSILS IN CHILDREN, with interesting and significant results. The tonsils studied were divided into two groups: No. 1, from children with tuberculosis of the upper cervical lymph nodes; No. 2, from children with enlarged tonsils, but no evidence of tuberculosis anywhere. There were 100 children in each group. In group No. 1 it was never possible to establish the presence of tuberculosis (except in the tonsils) other than the swollen cervical glands. Microscopic examination, however, showed 38 per cent. of the tonsils definitely tuberculous and animal inoculation in 92 cases gave 20 positive results. In group No. 2, 9 tuberculous tonsils were found and all 9 gave positive results on inoculation. The tubercles in these tonsils were found near the deeper portions of the crypts, directly beneath the surface mucosa and deep in the tonsil close to the capsule. As no evidence of pulmonary lesion was found in any case, Mitchell considers this evidence that the focus in the tonsil is primary. The infecting organism in many cases was of the bovine type which would point to the conclusion that the infection came from milk.

Schambaugh⁵⁹ considers that the question of removing tonsils in adults for the relief of systemic infections must be worked out in each case by close coöperation between the internist and the laryngologist. It is only recently indeed that the internist has begun to appreciate the role played by the tonsil in the production of rheumatism, nephritis, etc., and even more recently other diseases have been added to the list of possible focal infections of tonsillar origin. These are gastric and duodenal ulcer, various lesions of the eyes, as well as acute and chronic neuritis of the eighth nerve. He insists, however, that the tonsils must not be removed indiscriminately even from those suffering from systemic disease of focal origin—indeed, not unless, after careful study, it is apparent that the tonsil infection is the most likely source of the trouble. The throat specialist should not assume the responsibility of determining this point, but should share it with the internist, in order to avoid the risk of doing unnecessary operations.

Beck⁶⁰ hardly agrees with this position of Schambaugh's. He says: "I wish to make a broad statement that, with the exception of a few

⁵⁸ *Journal of Pathology and Bacteriology*, 1917, xxi, 248.

⁵⁹ *Annals of Otology, Rhinology and Laryngology*, March, 1917.

⁶⁰ *Ibid.*

contra-indications, every tonsil is better out than in, and I have no knowledge of a single instance in which the patient was worse off from the tonsillectomy than he would have been with the tonsils not removed." This applies to either adults or children, and the contra-indications admitted are: (1) All acute inflammations and infections, (2) luetic processes, (3) advanced tuberculosis, (4) advanced cardiovascular changes, (5) advanced diabetes, (6) true hemophilia, (7) blood-pressure over 225 systolic, (8) infants below one year of age, (9) grave mental diseases, (10) anyone who has never had a sore throat and is in perfect health, a *rara avis*.

That tonsillectomy is not overdone, or a fad, is proved by a mass of evidence of wonderful results following the operation, and he believes that it has undoubtedly come to stay. Like appendectomy and other standard surgical procedures it is making a stronger, better race and should not be hindered. When there is disappointment because a general systemic infection does not clear up at once following operation, patience must be maintained, as such a result often takes time; it is hastened, however, by the elimination of other possible foci and the use of autogenous vaccine. Disturbances of the glands of internal secretion are often markedly benefited by the removal of the tonsils. Rosenow and Nuzum, moreover, have shown that a small diplococcus was constantly present in the tonsils which, on being injected into rabbits, produced symptoms like poliomyelitis. In those suffering from infantile paralysis in the Cook County Hospital, Nuzum found that the disease was mild in all patients who had had tonsillectomies, and that those cases recovered most rapidly who had their tonsils removed subsequently.

Perry⁶¹ takes even a more radical view of tonsil removal than Beck. He goes on record as advising the removal of every tonsil at four years of age, irrespective of its condition, or as much younger as infection may indicate. In view of the tonsil's lack of any proven function, its ease and safety of removal and its baneful effect on the economy, he does not see how any scientific reasoning can arrive at any different conclusion. To back this opinion he points to the fact that Nature herself is the great tonsil operator, in that she aims to replace, after a certain period, all normal tonsillar tissue, with scar tissue. Unfortunately, this is often not accomplished through the development of pathological changes that endanger the health or life of the individual and make the tonsil persistent. Tonsil pathology should be diagnosed by systemic manifestations rather than by local appearances. Statistics from the school clinic in Seattle show that one child in every twenty has albumin which clears up after tonsillectomy. One in thirty has a heart lesion, considered to be of tonsillar origin, and a 3 per cent. increase in efficiency in all the schools is reported as a result of the campaign for tonsil removal. Moreover, the Health Department reports no cases of diphtheria or scarlet fever in tonsillectomized children, and this is supported by Welty, of San Francisco.

⁶¹ Laryngoscope, June, 1917.

Not so favorable is the study of the after-results of 1000 tonsil operations by Crouse, Watkins and Rothholz.⁶² In cases of infectious arthritis coming on several weeks after an attack of tonsillitis, removal of tonsils and adenoids seemed to improve or cure the condition in a large proportion of cases, though some few were not improved or were worse. In many of the cases it was months before all joint conditions had entirely subsided. In the group of "rheumatoid arthritis" the authors found but little improvement following operation, and in a number of cases the condition seemed worse, so that they conclude the operation should never, except in unusual circumstances, be done in this class of cases. There is a different story, however, in myalgia or myositis, of which all cases were cured. In acute rheumatic fever much improvement was noted, although a few cases showed recurrence later on, showing that the tonsil was not the only portal of entry of the infection. In chorea and Sydenham's chorea, from the results obtained, the authors consider the operation dangerous, especially during the acute stage. In cervical adenitis the best results were obtained, but it must be remembered that the teeth are also sources of infection as well as the scalp, and even if all foci are cleared up it takes time to dispose of the adenitis as well, more especially if it is tuberculous.

Beck describes a carefully planned operation in which he uses his snare tonsillectome, somewhat after the Sluder method, in most cases, but if this fails to at once engage the whole tonsil it is abandoned and a straight-forward dissection done. He lays much stress on the preparation and anesthetization of the patient, general anesthesia being used in practically all cases. The operation is done in the morning, with a light or no supper, a cathartic the night preceding, and no breakfast. The bowels are washed out and an injection of sodium bicarbonate allowed to remain as a precaution against acidosis. Atropine is given before the operation and a nitrous-oxide-ether sequence used for anesthesia. After removal of the tonsil, sponges are at once inserted into the fossa and gentle pressure maintained, but if bleeding continues more than half a minute the points are searched for, clamped and, if necessary, tied. If there is still oozing, a piece of rubber sponge is sewed into the cavity and left there for twelve hours. This latter procedure is carried out in all cases over sixteen years of age. After-treatment consists of painting the raw surfaces with tincture of iodine and gargling with weak, warm tea and seltzer water, equal parts.

Although the popularity of the LaForce hemostat tonsillectome seems to be constantly growing, many operators continue to use the original Sluder or the older dissection enucleation, while a few use the eversion method, which has the advantage of being very quick and often nearly bloodless, the former being a valuable asset when using a local anesthetic. It is, moreover, readily applicable to all classes of tonsils, and there is very little traumatism of surrounding structures.

Murphy⁶³ last year appeared as an advocate of CIRCUMCISION OF THE TONSIL, an operation devised by himself to liberate the anterior crypt

⁶² Bulletin of Johns Hopkins Hospital, 1917, xxviii, 1.

⁶³ Laryngoscope, September, 1917.

mouths from the often overlying plica triangularis. He claims that if this is thoroughly done it returns the tonsil from a pathological state to a normal, functioning one, and without any danger of deformity. The operation itself is simple. Under light local anesthesia the plica is separated from the anterior surface of the tonsil, from the top to the bottom, by a blunt elevator, curved on the flat. A right-angled punch is now used to bite away the detached plica to the margin of the anterior pillar, thus uncovering any hidden crypts that may exist. Tincture of iodine is applied and the operation concluded. The release from the restraint of the plica allows the superior constrictor muscle to force the tonsil more prominently into the throat, and many old cheesy plugs are forced out of the crypts.

Perry advocates an eversion similar to that practised by Lewis, Davis, Sheady and the writer, except that no inverted-U cut is made in the tonsil. A screw tenaculum is passed into the body of the organ to the capsule at its most distant and upper part. The tonsil is drawn inward into the throat and a Hurd pillar-retractor used to push the anterior pillar outward beyond the equator of the tonsil, which then everts, with its capsule "inside out" or rather "outside in." A snare severs all attachments. A suction pump is considered a necessity, also a head-down position and good light, and he believes that with this method no postoperative pneumonias or pulmonary abscesses will, or can, result. Indeed, nearly all operators now find it necessary to use some form of suction in this work.

COMPLICATIONS AND SEQUELÆ OF TONSILLECTOMY have, as is right, received considerable attention. Last year the subject of *pulmonary abscess* was discussed in detail and the reports then abstracted have brought this unfortunate sequela squarely before the profession. Since the publication of these reports, other observers have reported additional cases, and yet, considering the vast amount of this operating being done, it would seem that this complication is not at all a common one. The consensus of opinion seems to be that there is little danger if the anesthetic is properly administered, aspiration of infected blood prevented by a low-hanging head or the employment of suction, and both preoperative and postoperative care of the fauces given.

Gracey⁶⁴ reports a fatal case of *hemiplegia* following tonsillectomy under general anesthesia. The operation was done reasonably quickly, though there was a little more bleeding than usual. On the second day the patient got out of bed of his own accord and proceeded to the roof garden, thinly clad, during a cold wind. Following this he had a chill and a temperature of 105°, with frontal headache. The chills continued, as well as the fever, and there was a convulsion on the fifth day, followed by a noticeable hemiplegia of the left side. The blood count showed 15,600 leukocytes and a blood culture was negative. On the seventh day he became stupid, the paralysis continuing, lessened reflexes on the affected side, with some spasticity, no Kernig or Babinski signs. Cerebral embolism was diagnosed. Eye-grounds were negative, but the con-

⁶⁴ Laryngoscope, January, 1917.

vulsions continued, with fever, and death occurred on the tenth day. The spinal fluid had always been negative, and Gracey inclines to the opinion that there was an embolism in the motor area, probably septic, caused by the bleeding and coughing during operation, and with a localized meningitis.

Scruton⁶⁵ presents a case of *polyarthritis* and *pulmonary infarct* following tonsillectomy, with ultimate recovery. The operation was normal in all particulars, but a continued fever developed, accompanied by a marked leukocytosis, with a polynuclear count of 75 per cent. On the sixteenth day the diagnosis of pulmonary infarct was made. The cultures from an acute infection of the ear, shortly previous to operation, showed *Streptococcus hemolyticus*. The transmission of an embolus, though to a different area, links this case closely with the one of Gracey's just commented upon. Scruton believes that all cases operated upon for a history of joint infection should first be cultured for the *Streptococcus hemolyticus*.

Scruton,⁶⁶ furthermore, reports a case of hemiplegia which developed, probably, within a few hours after operation. Fortunately this case recovered, at least partially, in the course of a few weeks. He believes that undoubtedly an embolus was the cause, since there was no coma and no prodromal symptoms of brain-softening, and there was a rapid recovery. Six months after operation there was athetosis of the foot and hand, slow execution of movements in the arm and paralysis at the angle of the mouth.

Beck believes that no bad effects are to be expected on the speaking or singing voice after a well-done tonsillectomy, a position with which the late G. Hudson-Makuen was not in accord. Kenyon's work, calling attention to the danger of *voice impairment*, and ascribing to the tonsils a definite function as a support to the faucial pillars, was given last year, and he again⁶⁷ emphasizes his position, stating that any operation which aims at removing the capsule of the tonsil does definite injury to the voice through scar-formation and contraction. In a study of 161 tonsillectomized throats he found that the palatoglossus had ceased entirely to functionate in more than 50 per cent., and in only 14 per cent. did the muscle seem free from impairment. The palatopharyngeus was incapacitated completely in 15 per cent. and but very little in 49 per cent. He admits that often extensive palatal deformities have little effect on the speaking voice, although, on the other hand, it is often "nasalized." He considers that unless a better technic can be developed the situation as regards tonsillectomy is serious, a position with which, I think, but few will agree. He believes, with French, that in 80 per cent. of tonsils a tonsillectomy would give the necessary relief without voice impairment, which is such an important factor in the cases of singers, and calls for an intracapsular or modified operation, at least for this latter class.

Voorhees⁶⁸ has analyzed the results in 5000 tonsil operations in singers and finds no reason to fear any untoward results if the usual form of

⁶⁵ Laryngoscope, January, 1917.

⁶⁶ Ibid., February, 1917.

⁶⁷ Journal of American Medical Association, September 1, 1917.

⁶⁸ New York Medical Journal, December 16, 1916.

operation is employed in a skilful manner. It is only in cases in which the dissection has been done carelessly that the results are not always good. On the contrary, he finds that in most cases the singing voice shows a marked improvement and an increase in range of from one-half to a full tone. No laryngologist, however, should operate on the throat of a trained singer unless he has some knowledge of the art of singing. Voorhees believes, moreover, that postoperative care is of the greatest importance and that the throat should be seen daily until full healing has taken place.

Moore⁶⁹ finds that there is a remarkable number of fatalities and complications following tonsillectomy, regardless of its popularity, and that a great many unnecessary operations are performed yearly. He believes that practically complete tonsillar involution takes place in the majority of children about the age of puberty, a conclusion with which I cannot agree. I have, at this writing, and during the two months preceding, had the opportunity of inspecting the throats of a large number of mountaineers from the Carolinas and Tennessee, in the National Guard of the Army, and have been amazed at the great proportion of largely hypertrophied and infected tonsils found. Moore further believes that the prophylactic removal of tonsils appears very questionable, as the results, as reported by competent observers, have not justified the indications in most cases.

Frank⁷⁰ finds that non-diabetic *acidosis* is common in children with diseased and hypertrophied tonsils, adenoids and catarrhal conditions of the upper air tract. Anesthesia is considered the most common etiological factor, as we noted in this chapter last year. Children under twelve years show acetone in the urine within twenty-four hours after an anesthetic. This agrees with Beck's statement. The first sign of an impending acidosis is found in changes in the pulse rate, an increase being noted. Glucose is considered by Frank the best treatment, either by mouth or, in cases of irritable stomach, by rectum.

An interesting case of *heart failure* during an operation for the removal of tonsils is reported by Mollinson,⁷¹ in which heroic measures were resorted to. The anesthetic used was a mixture of chloroform and ether. At the conclusion of the operation it was noted that respiration had ceased, the pupil was dilated, corneal reflex gone and heart sounds were not heard with the stethoscope. The abdomen was at once opened and massage of the heart instituted at the rate of about 90 pressures to the minute. After some moments there were respiratory movements but no heart contractions. At some period between thirteen and twenty-four minutes after cessation of heart action the heart suddenly began beating again and continued to do so, though the patient was more or less unconscious for seven days. For some time also there was rigidity of the limbs and choreic movements. He also had a meningitis for four days and showed other symptoms of severe cerebral irritation due, no doubt, to the damage done to the brain during the cessation of the circulation, but there was eventually a perfect recovery.

⁶⁹ Medical Record, December 2, 1916.

⁷⁰ Annals of Otolaryngology and Rhinology, December, 1916.

⁷¹ Journal of Laryngology, Rhinology and Otolaryngology, August, 1917.

THE EAR.

Deafness. Richards⁷² says that the object of any hearing test is to determine the quantity of the deafness present and the location of such lesions so far as these tests can enlighten us. They are of the utmost importance for purposes both of prognosis and treatment. In using the forks he disregards the production of overtones by the higher forks, as the overtone dies away much more quickly than the real tone, so that our measure of value is fairly accurate in their presence. The whisper test is required for examination of recruits in the army and navy, and the official distance at which it must be heard is 20 feet, using only the residual air in the lungs. In perfect quiet the whisper will often be heard as far as 100 feet, and it is difficult therefore to exclude the ear not under examination, for the use of the Bárány noise-producer is often confusing. It is also difficult for the examiner so to standardize his voice that he will give it the same intensity at each examination. Mink⁷³ has devised an apparatus to correct this. It is a small megaphone fitting tightly around the lips of the examiner, and has a damper arrangement by means of which he is able to obtain a whisper of the same degree at any time.

As a test for total deafness, malingering and neuropathic deafness following shell shock, Gault⁷⁴ has his patient seated and the opposite ear tightly plugged. A loud bicycle horn is now suddenly blown about six feet away, the patient's eyelids, in the meanwhile, being closely watched with a magnifying lens. The sudden impression produced by this sound on the auditory nerve is always followed by either a slight or marked orbicular contraction. The test is negative in total deafness, while in neuropathic deafness, when some reaction was obtained and the patient so informed, rapid improvement was usually noted.

Gosset's⁷⁵ test for possible malingerers is to have the subject give the sound "Ah" in as high a voice as possible and then to run the scale as low as possible. The truly deaf stop when they reach the point below which they cannot hear their own voices, while the simulator continues to the base of the scale.

Stein⁷⁶ calls attention to that type of deafness in which the onset is sudden, without prodromal symptoms, and profound syphilis is, of course, the most common cause of such deafness, though many other conditions are often responsible. Traumatism and hysteria as causes may be dismissed with the mere mention of them, but cases often occur after the use of salvarsan, anaphylactic cases after the use of sera, the anemias and leukemias, diabetes, arteriosclerosis, mumps, pertussis and suppurative ear disease being also factors. The site of the lesion may be either in the labyrinth, the eighth nerve, or in the cranial cavity. Hemorrhagic effusions are a very common cause and are apt to occur in the hemato-poietic disorders like pernicious anemia, leukemia, etc., although, on the other hand, the symptoms may be due to local labyrinthine anemia.

⁷² Boston Medical and Surgical Journal, August 16, 1917.

⁷³ Arch. f. Oren-, Nasen- and Kehlkopfheilkunde, November 21, 1916.

⁷⁴ Presse médical, September 21, 1916.

⁷⁵ Progrès médical, January 13, 1917.

⁷⁶ Journal of American Medical Association, September 1, 1917.

According to Schlittler⁷⁷ a large percentage of the Swiss army suffers with ear disease, and he refers to similar reports by Mauthner, in 1915, on the Austrian army, and Ostmann, in 1900, for the German army. Chronic otitis media forms 25 per cent. of these cases and is the cause of rejection for 45 per cent. of the recruits. If taken early enough most of these cases can be cured, and school inspection is of the greatest value in discovering them, so that, eventually, they will be fit subjects for military duty. In one city it was found that there were 2500 deaf children among 23,000 examined, 25 per cent. of these being middle-ear disease. Mackenzie⁷⁸ feels that there are certain factors which delay the healing of acute suppurative middle-ear processes, thus allowing them to become chronic, most of which can be prevented. Such factors are adhesive bands in the middle-ear left by previous attacks of inflammation and obstruction of the Eustachian tube at any point in its course. In the case of the latter a simple mastoid operation will frequently clear up the middle-ear condition and the tube as well, thus preserving the function of both. Adenoid growths, infected and hypertrophied tonsils and nasal obstructions and infections are all distinct and more or less direct causes of chronicity in these cases, and their removal often accomplishes or accelerates a cure. Tuberculosis and syphilis are both potent causes of chronicity, and both, if recognized early enough, may frequently be so handled that acute suppuration does not become chronic with the loss of function. Care of the ear alone in these cases will usually fail to effect a cure.

It is still firmly believed by many writers that *tuberculosis* plays a much more frequent part in middle-ear suppurations than it is given credit for. Lermoyez⁷⁹ found it present in 10 cases out of every 90 osteomyelitic cases and 20 per cent. of tuberculous otorrheas were bilateral. The great majority occur in childhood, but in adult life there is a great preponderance of affected males over females. Lack of normal hearing after a simple mastoid operation makes us suspect a tuberculous process, and the history of insidious onset is important. Taken in connection with the paradoxical deafness, the white caries, pale granulations and persisting fistula the diagnosis can frequently be made and readily confirmed by the finding with the microscope of tuberculous follicles in the granulations and by the inoculation of a guinea-pig. Tuberculin tests are to be avoided in these conditions as they may have disastrous effects on the ear, facial paralysis, labyrinthitis or even meningitis supervening.

Dunlap⁸⁰ brings forward the so-called

Okuneff Method for Closing Perforations of the Tympanic Membrane of long standing. The method itself is simple. Cocaine is applied to the edges of the perforation and carefully wiped off again after anesthesia is obtained. The edges are then carefully wiped with trichloroacetic acid. If the cocaine is not first removed a white precipitate occurs which diminishes the effect of the cauterization. Fifteen cases are reported successfully closed by this

⁷⁷ Correspondenz-Blatt für schweizer Aerzte, June 16, 1917.

⁷⁸ Journal of American Medical Association, January 6, 1917.

⁷⁹ Presse médicale, July 26, 1917.

⁸⁰ Laryngoscope, February, 1917.

technic, though in several cases months were consumed before the cure was complete. The length of time allowed to elapse between each application depends on the amount of scar tissue making up the edge of the perforation, and, secondly, the vitality of the ear drum itself. The rapidity with which this scar tissue is destroyed and replaced by healthy granulating tissue determines this time, which is usually found to be about three to five days between treatments. The perforation will not begin to close until there is an entire circle of granulating tissue. Once a perforation starts to close, however, progress to a cure is very rapid, the perforation, no matter what its previous shape has been, first becoming circular. In very thin membranes during the early treatments the perforation becomes much larger, owing to the fact that tissue of low vitality must be destroyed until a sufficiently healthy margin is secured. So the treatments must be persisted in even if at first the condition seemingly is made worse. As the case progresses, cauterization is done less and less frequently or a weaker solution of the acid used. In these cases the hearing was universally improved and there has been no subsequent tendency toward future middle-ear inflammation during repeated attacks of rhinitis.

Fraser and Muir⁸¹ have given us a careful study of OTOSCLEROSIS associated with otitis media suppurativa, including the pathology. They believe this disease to be an *infection*, and their conclusions from the study of these cases are of unusual interest, though lack of space will not permit giving the details of their work. They conclude as follows:

1. Some cases of otosclerosis (spongification of the labyrinth capsule) appear to be of the nature of a blood infection and may be called "primary." We would expect that further research would show that in these cases the bony changes are widespread throughout the skeleton.

2. Other cases of otosclerosis undoubtedly follow attacks of catarrhal or purulent otitis media, the infective process invading the labyrinth capsule at the anterior margin of the oval window. Such cases may be called "secondary."

3. From the clinical stand-point, heredity plays an important part in otosclerosis, but, as the condition is a chronic inflammatory process, the infective agent must gain access to the labyrinth capsule either through the blood stream or from the middle-ear cleft.

4. It has been proved by clinical and microscopic research that "atypical" cases of otosclerosis exist in which functional examination of the ear reveals the presence of nerve-deafness. The relationship between the bony changes and the nerve affection is not yet clear.

The Mastoid. Loeb⁸² has stated that cases of ACUTE HEMORRHAGIC MASTOIDITIS are rare and that such cases are only discovered by operation when the hemorrhagic process is still active or by postmortem when death has occurred early in the disease from an intercurrent complication. Dench,⁸³ however, uses the term lightly and speaks as if this was a

⁸¹ Journal of Laryngology, Rhinology and Otology, November, 1916, and September, 1917.

⁸² Annals of Otology, Rhinology and Laryngology, September, 1915.

⁸³ Journal of American Medical Association, September 15, 1917.

common form of mastoiditis. Loeb describes a very distinct condition with at least a significant history. In his case there was a spontaneous rupture of the membrana tympani, with abundant discharge of sero-sanguineous fluid but without relief from the great pain and tenderness that accompanied it. After four days of this condition without abatement, with fever and a high pulse rate and with a leukocytosis of 15,900, with a polymorphonuclear percentage of 78, the mastoid was opened. The soft parts were not swollen and no pus was found in the mastoid cells, but, instead of this, every cell was filled with a reddish-blue blood clot. This was so evident that each cell could be outlined by the blue color showing through the thin bony partition. Convalescence was slow but recovery was otherwise uneventful. For a week following the operation the leukocyte count ran between 31,900 and 21,700. The cultures taken from the clots in the mastoid cells showed diplostreptococci, which on bouillon growth proved to be almost exclusively diplococci with a few short chains. These were the same organisms as were obtained from the primary otitic discharge. The organism differed from that described by Davis and Rosenow, which was encapsulated and Gram-positive, these being Gram-negative. This difference may be accounted for, according to Rosenow, by cultural conditions within or without the body. The hemorrhagic character of the inflammation would indicate a virulent type of infection, which justifies the early operation done, especially when taken in conjunction with symptoms increasing in severity, in spite of copious discharge and increasing leukocytosis. This case well demonstrates the occurrence of an acute hemorrhagic mastoid inflammation of bacterial origin and that such an infection may be coincident with, as well as dependent upon, a middle-ear inflammation.

The question of EMBOLIC PNEUMONIA FOLLOWING MASTOID OPERATIONS has been discussed by Richards,⁸⁴ who wonders if there are not many more of these cases than are recognized and whether the possible occurrence of localized mural thrombi of the lateral sinus should not be considered in the after-healing of mastoid cases, even when the classical picture of sinus thrombosis is absent. He reports 3 such cases occurring in his practice in four months, in all of which there was a sudden attack of pain in the chest, which appeared from the physical signs to be due to shutting off of a portion of the lung as the result of an infarct following an embolus, and with accompanying pleurisy. In all 3 cases the signs appeared on the same side as the ear infection, although in one case both sides suffered. The attacks came on from the second to the twenty-eighth day.

The INDICATIONS FOR THE MASTOID OPERATIONS IN ACUTE OTITIS MEDIA are well set forth by Dench,⁸⁵ who reminds the profession that the mastoid is simply a part of the middle ear and partakes of the inflammation in practically every case of acute otitis media. A middle ear acutely inflamed and properly drained by early free incision of the drum membrane recovers spontaneously, and this is really a case of mastoiditis

⁸⁴ Boston Medical and Surgical Journal, August 10, 1916.

⁸⁵ Journal of American Medical Association, September 15, 1917.

recovering with a minimum of surgical interference. If this drainage, either on account of the severity of the inflammatory process, the particular topography of the mastoid, or the extreme virulence of the infecting organism is insufficient, a mastoid operation is indicated, which simply means securing better drainage through a posterior incision than can be secured by that through the drum membrane.

There are a great many indications for operation which must be considered in the management of many cases of acute otitis media not usually classed as having acute mastoiditis. If, after free and satisfactory incision of the drum membrane, pain in the ear persists for more than twenty-four or forty-eight hours, and is sufficient to require an opiate, this alone is sufficient indication for mastoid drainage. These are the cases, alluded to above, that Dench considers to have mastoiditis of the hemorrhagic variety and in which there is extensive development of the mastoid cells. Many cases run an afebrile course as well as having high temperature ranges, so that neither the presence nor absence of fever can be much of a guide. Local tenderness is, of course, considered one of the most valuable signs, but it must be remembered that in the pneumatic type of mastoid there may be exquisite tenderness within a few hours after the inception of an acute otitis media, and this is not an indication for immediate operation, as many of these cases recover without operative interference other than incision of the drum. The situation of the tenderness depends on the topography of the mastoid, the large tip cell cases becoming tender very quickly and returning to normal slowly after free drainage is established. Antrum tenderness is more valuable, and of particular significance is a tenderness that begins at the tip, disappears and, after the lapse of some days, reappears over the antrum. This is ordinarily considered a sign that the mastoid disease will be relieved only by posterior drainage.

Dench firmly adheres to the well-established sign of a sagging posterior canal wall. He described this as a narrowing of the canal at the fundus, a persistent bulging of the upper and posterior portion of the drum membrane and a sinking of the corresponding adjacent meatal walls. This sign, present ten days after the beginning of trouble, is considered a positive indication for operation.

Some stress must be laid on the bacteriological examination of the discharge from the middle ear which should be made in every case. A smear is sufficient if stained so as to show the presence or absence of a capsulated organism. Of course, such a smear usually shows many different organisms, but the predominating one is usually causative, and such can be picked out and determined. The *Streptococcus capsulatus* is considered the most dangerous organism and one that almost invariably demands operative interference. At any rate these cases should be watched with exceeding care, and no case considered safe until all parts have returned to absolute normal, for they may come to operation months after the healing of the drum membrane.

A sudden cessation of discharge, taken with positive canal signs, calls for operation, as well as a very profuse one lasting more than three weeks, after incision of the drum membrane. An acute inflammation of the

middle ear that will recover at all will do so within three weeks or even within ten days after drainage is established, and if it lasts longer it means that the tympanic drainage is insufficient. If there has been a spontaneous rupture and a purulent discharge lasting for four or five weeks it is much safer to establish posterior drainage. Some of them, to be sure, get well without it after longer periods of time, but much damage to the ear is done, and many of them require operation at a later period. In some of them there exists an unexplained toxemia with certain indefinite symptoms, such as headache, malaise, loss of flesh, muscular pains, etc., with much impaired hearing, and often disturbances of equilibrium, showing that though apparent recovery had taken place the old focus of infection had, in reality, never entirely cleared up.

The history of a case seen in consultation helps definitely to determine the question of operation. Those cases with a history of repeated incisions of the membrana tympani, especially with a duration of the disease for several weeks, should be considered operative cases. One single competent incision of the drum membrane will drain the middle ear and adjacent structures perfectly if such drainage is possible through the drum. The moment that it is necessary to repeat these incisions the indication for posterior operation becomes imperative. Dench condemns such repeated incisions utterly. When there is profound impairment of hearing in a case of acute middle-ear inflammation, either with or without a perforation, a mastoid operation should be done, for if there is sufficient involvement to cause profound impairment of hearing persisting for several weeks, it is an indication that the mastoid cells have become so involved that tympanic drainage will not be sufficient. The middle ear is a small cavity and should be easily drained by a drum incision, or in the milder cases without perforation the secretion should be absorbed after a reasonable interval of time.

The value of the *roentgen ray* in the diagnosis of mastoid disease is accepted by Dench as beyond question. Dixon⁸⁶ reports 288 cases positive to the *x*-rays in which 201 were confirmed at operation; in 37 no operation was done and in 50 the cases were lost track of or refused operation. In not one of the operative cases was the *x*-ray diagnosis disproved. In 115 cases reported negative after *x*-ray study, 15 were operated upon on clinical evidence, and, of these, 7 were thus proved not cases of mastoiditis.

In the taking of *x*-ray plates of the mastoid, Dixon endeavors to superimpose the internal on the external auditory meatus. The patient is placed prone on the table with one arm flexed before the face and the other extended at his back on the table, the head resting on an incline of about 168 degrees. The tube is adjusted at a right angle to the table, not to the incline, and the center at, or a little below, the parietal eminence. By this means the opposite mastoid is thrown out, the internal meatus shows black and the external gray, and surrounding it the mastoid cells show up well and the relative position of the sigmoid sinus is shown without the need for stereoscopic plates. If the line marking the anterior

⁸⁶ Journal of Electrotherapeutics and Radiology, December, 1916.

border of the sinus groove is at right angles to Reid's base line the sinus is forward; if covered with cells, it is deep; if not clean cut, or with cells overlying, it is superficial; and if it does not show at all, it is shallow and probably well below the outer table, but probably not forward.

Carter⁸⁷ calls attention to the fact that middle-ear and mastoid disease may be complicated by *gas-bacillus infection* which he thinks gains access to the mastoid through the middle ear. His case had a history of an acute attack of otitis media two years before, with suppuration at intervals since then, which had never been treated, having subsided spontaneously after a profuse, purulent discharge. On admission he was very sick, temperature 102°, facial paralysis and great swelling of the right side of the head and neck. On operation, as soon as the skin was incised the blood appeared to be charged with gas, escaping in fine bubbles. The periosteum was reached through an inch and a half of edematous, emphysematous tissue, and, as soon as incised, there was an explosive discharge of foul-smelling gas followed by thin, fetid, greenish-yellow pus which was said by observers to have the characteristic odor of gas-bacillus infection. The antrum was found full of cholesteatoma and there was a tip perforation. Carter thinks that the interesting features of this case are:

1. The rarity of gas-bacillus infections of the mastoid.
2. The unusual route through which the infection gained an entrance, namely, through the middle ear; the usual mode of entrance of this bacillus into the body being through an open wound or abrasion into which earth has been ground.
3. The prompt recovery following the operation, an unusual sequel to gas-bacillus infections, for these cases usually succumb very quickly.

The Labyrinth. Due to the energetic efforts of a certain group of otologists, including Duel, Jones, Schambaugh, Kerrison, Brumm and Fisher, the subject of labyrinth reactions, for the diagnosis of vertigo and endocranial lesions, has been kept constantly before the profession, much to the benefit of patients and profession alike. The whole subject is so new and yet such great strides forward have been made that it seems reasonable to devote some space to these papers, even at the risk of repetition, for it is an intricate subject and much educational work is necessary. To the internist the possibilities of absolute diagnosis in cases of vertigo, and to the brain surgeon the localization of endocranial pathological conditions, make the subject one that must be considered in their study of such cases.

Fisher⁸⁸ regards dizziness or vertigo as a distinct clinical entity, with a definite etiology. It results from some interference, either by destruction or irritation, with the function of some part of the apparatus of equilibrium and its various nerve tracts. The fibers carrying the impulses producing vertigo find their cortical representation in centers, which Mills postulates to be located in the posterior portion of the second temporal convolution of each side, adjacent to the cortical area of hearing. In making the now well-known ear tests, some points in interpretation

⁸⁷ Medical Record, July 21, 1917.

⁸⁸ Pennsylvania Medical Journal, December, 1916.

must be borne in mind. If, after stimulation, there occur no responses, such as nystagmus, vertigo, etc., the lesion is either in the labyrinth or the eighth nerve. If, however, any one response goes through normally, it eliminates the labyrinth and nerve as the seat of the lesion, as they themselves must necessarily be unaffected in order to have produced any one normal response. If stimulation of the ear fails to produce nystagmus, the lesion must be along the pathways from the ear to the eyes, in the vestibulo-ocular tract. So, also, if there is no vertigo produced, the lesion should be placed in the vestibulo-cerebello-cerebral tract. The presence of a normal nystagmus after stimulation, with an absence of vertigo, would indicate a normal tract from the ear to the eye, but an involvement of the tract between Deiters's nucleus and the cerebral cortex. Fisher explains the routine method of analysis in cases of dizziness as follows:

1. When the results of ear stimulation are nystagmus none, vertigo none, past-pointing none, and falling none, we are obviously dealing with a destruction of the labyrinth or the eighth nerve produced either by a toxemia (acute or chronic), hemorrhage, inflammation or a tumor. We, of course, have the corroborative evidence of a complete deafness in that ear. There is always present, beyond a doubt, a complete destruction of the labyrinth or eighth nerve when we have a picture of a dead auditory apparatus as well as non-responsive semicircular canals.

2. Should stimulation of the horizontal semicircular canals produce nystagmus none, vertigo normal, past-pointing normal, the lesion indicated is in the medulla oblongata, between Deiters's nucleus and the posterior longitudinal bundle.

3. If stimulation of the vertical semicircular canals produces nystagmus none, vertigo normal, past-pointing normal and falling normal, the lesion indicated is in the posterior portion of the pons near the posterior longitudinal bundle.

4. If stimulation of the horizontal semicircular canals gives nystagmus normal, vertigo none and past-pointing none, the lesion suggested is in the inferior cerebellar peduncle on that side, or at a point farther up along the vestibulo-cerebello-cerebral tract in the pathway for dizziness.

5. If stimulation of the vertical semicircular canals produces nystagmus normal, vertigo none, past-pointing none and falling none, the lesion indicated is in the middle cerebellar peduncle, or at some other portion of the vestibulo-cerebello-cerebral tract, higher up.

6. If stimulation of the horizontal semicircular canals and also of the vertical semicircular canals produces nystagmus none, vertigo normal, past-pointing normal and falling normal, there is indicated a lesion of the posterior longitudinal bundle.

7. If stimulation of the horizontal and vertical semicircular canals produces nystagmus normal, past-pointing none, falling none and vertigo none, it indicates a lesion of the cerebellar nuclei of that side where the fibers from the inferior and middle cerebellar peduncles come together, or in the upper portion of the pons where all these fibers again come together at the decussation of these fibers in the superior cerebellar peduncles.

Fisher⁸⁹ points out that:

1. Equilibrium of the body is maintained chiefly by the ear and its associated pathways and centers known as the vestibular apparatus, aided by the sense of sight and muscle sense.

2. Vertigo is a sensation perceived within the brain when perfect equilibration is interfered with.

Vertigo resulting from disease is entirely different from that produced experimentally. It results whenever there is an interference with the perfect balance between the special static organs of each side. Both ears always act in unison and are constantly sending out an equal flow of impulses to the musculature of the body ensuring perfect equilibrium. The important thing to be remembered is that it is always a disturbance of the ear and its associated pathways that produces vertigo, and nothing else can result in vertigo. When disease in remote organs causes vertigo, it is only because of a definite influence on the ear mechanism.

Vertigo may be caused by—

1. Lesions within the internal ear, such as labyrinthitis of the various types, or effusions or hemorrhage within the internal ear. Inflammatory conditions of the middle ear, for instance acute otitis media or mild inflammation of the inner ear itself, produce only irritative effects if any, so that the patient suffers from more or less vertigo so long as the acute state of the congestion lasts; the vertigo vanishing with the disappearance of the inflammation. On the other hand, slow degenerative changes within the labyrinth or sudden destruction of the whole, or a part, of one labyrinth is accompanied by marked vertigo, nausea, and vomiting, and loss of equilibration. Sudden destruction of the whole or a part of the labyrinth may be produced, rarely by trauma, but usually by hemorrhage or serous effusion into the labyrinth, and it may occur in the course of diabetes, Bright's disease, or of any condition in which the vascular system becomes affected. It is this class of cases that exhibits the so-called Ménière's symptom-complex. The hearing in these cases usually is markedly affected, if not altogether lost, and the condition is characterized by repeated attacks with a suddenness of onset, the violence of the symptoms quickly reaching a climax and then gradually subsiding, and all disappearing when the brain centers have acquired the function of compensation.

2. Toxemias affecting the ear or other portion of the vestibular apparatus, such as ptomain poisoning, constipation, alcoholism, poisoning by chemicals, as, for example, lead poisoning, nephritis, gout, rheumatism, syphilis and the toxemia of infectious fevers, such as scarlet fever, typhoid fever and mumps.

3. Definite lesions along the pathways from the ear within the brain itself, such as tumor, hemorrhage, thrombus, infarct, abscess, gumma, tubercle, specific neuritis, multiple sclerosis, syringomyelia, poli-encephalitis or meningitis.

If vertigo can be produced only by disease affecting the vestibular apparatus, then it follows that in order to determine the cause of vertigo,

⁸⁹ American Journal of Surgery, March, 1917.

we must employ those tests that differentiate the function of this apparatus. Such an examination comprises a search for any spontaneous vestibular phenomena that may be present, as well as an analysis of the responses to ear stimulation. Of the two methods, the latter is by far the more important. We start out with a fixed and definite idea that a normal internal ear, intact nerve pathways leading to normal nerve centers, will *invariably* produce a rhythmic nystagmus and vertigo when a stimulus is applied.

The nystagmus lasts twenty-six seconds in a certain direction when the individual is turned in a chair ten times, and the vertigo also is of twenty-six seconds' duration. Because of the vertigo there also appear past-pointing and falling. If, on the other hand, stimulation of the internal ear fails to produce one or all of the responses, the evidence points positively to an impairment at some point of this apparatus. If stimulation produces poor nystagmus, the block is obviously in the vestibulo-ocular tracts; whereas, if it is the vertigo which is subnormal after stimulation, the block must be located along the vestibulo-cerebello-cerebral tracts—those concerned with the production of vertigo. A knowledge of the course that all tracts pursue within the brain substance enables one to locate accurately the site of the lesion responsible for the vertigo. However, it not infrequently happens that patients complaining of vertigo when tested show normal reactions to ear stimulation. In these cases it is obvious that we are dealing with a condition in which the vestibular apparatus is irritated at some point, and a search should be made for such a source of irritation. This may be a focus of infection in the tonsils, teeth, stomach, kidneys, etc.

1. There can be no vertigo unless there is a disturbance of the vestibular apparatus. When disease in remote organs is accompanied by vertigo, it is because such a pathological state somehow or other affects the vestibular apparatus.

2. Vertigo may be due to simple irritation of the vestibular tract. In such a case it is temporary and fleeting in character, leaving the apparatus itself intact, and the tests will therefore show normal responses.

3. Vertigo may be produced by a lesion of the internal ear itself.

4. Vertigo may be produced by a lesion situated within the brain along some pathway in association with the ear.

5. Disturbances of the vestibular apparatus, with vertigo, can be definitely diagnosed and differentiated by means of the ear tests.

These associated pathways are briefly described by Jones⁹⁰ as follows, and it is very necessary for anyone attempting this work to keep this constantly in mind, as it forms the ground work for the interpretation.

1. The fibers from the horizontal semicircular canal pass through the eighth nerve, enter the brain stem at the junction of the medulla oblongata and pons, and continue directly to Deiters's nucleus and there divide into the two pathways: (a) The vestibulo-ocular tract, concerned in the production of the nystagmus. These fibers go from Deiters's nucleus to

⁹⁰ Pennsylvania Medical Journal, December, 1916.

the posterior longitudinal bundle through which they pass to the various eye-muscle nuclei, from which, through the third, fourth and sixth nerves, they are distributed to the eye muscles themselves. (b) The vestibulo-cerebello-cerebral tract, responsible for the vertigo. From Deiters's nucleus this path enters the cerebellum through the inferior cerebellar peduncle to the three vestibular cerebellar nuclei of the same side, from which it proceeds upward through the superior cerebellar peduncle and continues to the cerebral cortex on both sides, but more particularly the opposite side, through the crura cerebri and the internal capsules. The cortical areas which receive these fibers are postulated by Mills to be in the posterior portion of the second temporal convolutions adjacent to the cortical area for hearing.

2. The fibers from the vertical semicircular canals have a very different course; after passing through the eighth nerve they immediately ascend into the pons and at a point above the middle of the pons they have a division into two pathways similar to the division of the horizontal canal fibers at Deiters's nucleus: (a) The vestibulo-ocular tract, the fibers entering the posterior longitudinal bundle. (b) The vestibulo-cerebellar-cerebral tract reaches the cerebellum through the middle cerebellar peduncle, entering the cerebellar nuclei of the same side, from which the pathway is identical to that of the fibers from the horizontal canal, through the superior cerebellar peduncle to the cerebral cortex of both sides.

Jones⁹¹ further classifies under separate headings the various types of conditions that produce vertigo.

1. Involvement of the ear mechanism by a lesion in the ear itself.
2. Involvement of the ear mechanism by a lesion involving the intracranial pathways from the ear.
3. Involvement of the ear mechanism by ocular disturbance, either through the eye-muscle nuclei, or through association fibers from the cuneus to the cortical terminus of the fibers from the ear, in the posterior portion of the first temporal convolutions.
4. Involvement of the ear mechanism by cardiovascular disturbance.
5. Involvement of the ear mechanism by toxemias from any organ or part of the body.

Apropos of the first class mentioned above, Kerrison⁹² considers the vertigo produced by *suppuration of the labyrinth*, both in the acute and latent stages. In the acute stage it is found invariably associated with spontaneous vestibular nystagmus, subjective sensations of the rotation of surrounding objects in the plane of the nystagmus, and a tendency of the patient to fall or move in the plane of the nystagmus and opposite to the quick eye movement. The vertigo is increased when the patient turns his eyes in the direction of the quick movement, and lessened when he looks in the opposite direction. These constitute the characteristic syndrome of the acute stage of the disease.

The vertigo of the latent stage, however, is not constant nor invariably noticeable or prominent. It is simply the liability of the patient to a

⁹¹ Journal of American Medical Association, September 8, 1917.

⁹² Ibid.

sudden, violent and usually quite unexpected disturbance of equilibrium. The attack is usually brief and is induced by some body position or physical effort to which the patient has not become reëducated or reaccustomed, such as sudden turning, looking upward, etc. This vertigo gradually disappears as the auxiliary senses of equilibrium take up the work of the damaged semicircular canals.

Kerrison treats his cases of diffuse labyrinthine suppuration in the acute stage, when there is no immediate threat of intracranial infection, by absolute rest in bed, little local treatment, and avoidance of all bone surgery not imperatively indicated. In the latent stage a radical mastoid operation should be done, combined with careful surgical drainage of the labyrinth, which is the only treatment in accordance with sound surgical law. Vertigo in any suppurative lesion of the ear is always a symptom to be treated seriously. If the suppurative process is confined to the tympanum and the labyrinth only indirectly affected, it is often a question as to how far one should go in the surgery of this condition, but if the vertigo is clearly the result of labyrinth infection, thorough drainage is indicated, since these patients do not die of the labyrinthitis *per se* but as a result of secondary intracranial infection.

In the consideration of suppurative labyrinthitis, Duel⁹³ considers two tests of supreme importance, namely, the noise apparatus to determine quickly and positively total loss of hearing, and the caloric reaction whereby one may test the presence or absence of static function in each ear separately. The rotation test can never cause a reaction in one ear alone, if both are functioning, and even if one side is destroyed, it is well known that compensation soon takes place, and that therefore a negative result is never convincing. He believes this test to be absolutely useless in an acute case where there is a spontaneous nystagmus, in which there is already so much imbalance that the added phenomena produced by turning are only confusing and difficult of accurate observation. It is also deemed unwise in the extreme to subject a patient with acute labyrinth infection to this added discomfort, which might very readily be a danger. Duel also condemns the rotation test altogether as an aid in labyrinthine surgery, since the caloric test fulfils all purposes and is much more accurate and positive. The much-disputed galvanic reaction is put in the same category, for, while at times it makes the diagnostician test each ear separately, it has been demonstrated that it is capable of exciting reactions, by stimulating the nerve trunk, even when the end-organs were destroyed. Duel condemns the fistula test as being possibly dangerous because, used indiscriminately, without knowing the condition of the labyrinth, frail barriers may be broken down and a circumscribed lesion or a perilabyrinthitis converted into a diffuse one. Moreover, in the presence of a positive caloric test and any hearing remaining, the surgeon can well afford to wait and discover the presence of a fistula, if there is one, at the time of the radical operation on the mastoid, at which time, of course, and under these conditions, the fistula is left strictly alone. In an acute suppurative endolabyrinthitis it is not con-

⁹³ Boston Medical and Surgical Journal, March 8, 1917.

sidered to be an operative case if there is any function remaining in any part of the internal ear. A case of acute labyrinthitis showing no symptoms of endocranial involvement stands a better chance of recovery unoperated until the acute symptoms have subsided. During this time there should be complete rest, and this means that he should not be harassed by the whirling chair. There are two symptoms which justify the waiting for an acute case to subside. They are total loss of hearing, as demonstrated by a noise apparatus shutting out the sound ear completely, and a nystagmus of the vestibular type, no matter whatever other character it may have. If the nystagmus, indeed, shows a slow movement away from the diseased side it is a sure sign that that labyrinth is functioning and that the nystagmus is the result of stimulation or irritation rather than destruction. In these cases there is usually cochlear function present also. Such a case is, of course, never a case for operation.

On the other hand, there are certain symptoms that may occur during the waiting period, which indicate operation. Fever over 100° , with headache, photophobia, exaggerated reflexes, etc., might readily indicate a beginning meningeal involvement, which could be confirmed by lumbar puncture. In such a case the labyrinth drainage should be supplemented by thorough exposure and drainage of the meninges.

Chronic cases show no gross manifest symptoms due to the fact that compensation has taken place. In such cases there is no objection to using the rotation test, and any test showing unstable equilibrium is of value. But none of these is necessary. If in the presence of a chronic suppurative otitis media, it is demonstrated by the two tests mentioned above as indispensable, that the labyrinth is "dead," a fistula test is considered quite as dangerous as in an acute case.

While there is considerable difference of opinion as to when and how to operate on these chronic cases, Duel thinks that no radical operation should be done on an ear showing a dead labyrinth without the intention of entering that labyrinth if appearances at the time of operation indicated it. Such an operation should be done with extreme care and with the full knowledge that it may, if not so done, convert a latent labyrinthitis into an acute meningitis. If such a careful operation is done that no old barriers are broken down and no lead found into the labyrinth, drainage of the latter cavity may safely be omitted. Only occasionally will such a case later require a labyrinthine exenteration, owing to the fact that latent foci of infection were present, which did not show sufficient gross evidence on inspection to lead the operator to enter it at the first operation.

The type of operation for the acute case with early symptoms of meningeal involvement should be one that drains the dura as well as the labyrinth. The vestibule must be opened both in front of and behind the facial nerve, the cochlea uncapped, and the scala and modiolus entirely removed, so that the meningeal fluid washes freely through. The plate from the lateral sinus to the petrous pyramid must be removed and the dura slit and drained at a point as near the internal auditory meatus

as possible. A ribbon of rubber tissue inserted through this slit greatly facilitates drainage.

Some change in the form of operation is desirable for a chronic case, with only a suppurating labyrinth to be drained. It should be opened in front and behind into the vestibule, and great care used in uncapping the cochlea so that the modiolus is not disturbed, in order not to provide a pathway for the infection to the meninges. If the granulating and suppurating cavities are thoroughly opened and washed out they will heal rapidly, with no spread of the infection; but if the granulations are curetted there is danger of opening an avenue of infection through the aqueductus cochlea or the aqueductus vestibuli. The removal of the inner plate from the sinus to the pyramid serves no useful purpose here but prolongs the operation and adds to the danger.

Last year a suggested classification of labyrinthine disease was given in these pages. Ducloux commends this classification, since the types given in the older nomenclature are impossible of differentiation and all arise from a suppurative otitis.

Meningitis. In otogenous meningitis, Borries⁹⁴ has found sterile spinal fluid throughout the whole course of the disease in 8 cases which came to a fatal termination. In all but 1 the infection entered by way of the middle ear and mastoid—the 1 was a case of labyrinthitis. In each case there was either sinus thrombosis or subdural abscess. He says that it is evident that purulent internal pachymeningitis may induce meningitis with a constantly sterile cerebrospinal fluid and approximately normal otherwise, the danger lying in the concomitant purulent internal pachymeningitis. Lumbar puncture must be repeated often, as either positive or negative findings may be found at different times. Finding a sterile fluid in the presence of marked meningitic symptoms should point to pachymeningitis or circumscribed suppuration.

Muhsam⁹⁵ regards the use of *repeated lumbar punctures* as equivalent to free incision and drainage in other parts, and does not hesitate to withdraw as much as 100 c.c. at a time, no bad results ever happening. The compressed nerve centers are thus relieved and the bacteria are drained away. This should be repeated daily until the completion of the case and by these methods he reports a mortality of only 5 per cent.

Crockett⁹⁶ heartily agrees with the above method, doing his lumbar punctures as often as twice daily if necessary, but withdrawing only 20 to 30 c.c. at a time. He believes, however, that no harm, other than the usual transient, severe headache, results, and that as much cerebrospinal fluid as can be obtained may be withdrawn. He does not confine his treatment to this method alone but combines it with *subtemporal drainage*, these two procedures being of about equal importance. In 1909 Crockett reported 20 per cent. recoveries by this method on 6 cases, and in his present series of 6 cases there were 3 recoveries—50 per cent.—

⁹⁴ Ugeskrift for Læger, June 12, 1917.

⁹⁵ Berliner klinische Wochenschrift, November 27, 1916.

⁹⁶ Transactions of American Laryngological, Rhinological and Otolological Society, 1916.

but he thinks the latter is accidental and too high. The trouble with statistics of this kind in the past has been the lack of an absolute diagnosis of infective meningitis in some cases, which may account, in part, for Muhsam's very low mortality. Crockett does not much believe in the so-called serous meningitis, thinking that most cases so diagnosed are in reality localized septic leptomeningitis or cases of diffuse infective cerebrospinal meningitis where the cerebrospinal fluid has not been properly studied. His method of treating cases of meningitis of otitic origin is by subtemporal drainage and adequate and sufficient lumbar punctures. The opening in the skull should be made as near the upper border of the external auditory canal as possible. At times this is done in connection with the performance of the mastoid operation, which is, of course, always done in these cases; at times, however, the trephine opening is made independently through a relatively clean field. In order to avoid cerebral hernia the opening should be small, between one inch and one inch and a quarter. Previous to opening the dura the assistant makes a lumbar puncture, while the finger of the operator on the dura can accurately gauge the amount of relief from pressure as the cerebrospinal fluid is withdrawn. This pressure must be reduced to the point where it is distinctly subnormal, and, when this is attained, a slit in the dura is made and a drain made of a piece of rolled rubber dam is inserted between the dura and the pia along the top of the petrous portion of the temporal bone, nearly to the internal auditory meatus. The operation should be done quickly to avoid shock. The drain can be left in position for a week or ten days, the lumbar punctures being continued in the meanwhile. Failure to keep the intracerebral pressure low results in pressure against the opening in the bone and consequent obstruction of drainage.

The operation has so far not been successful in young children where the difficulty of keeping up the strength by forced feeding is usually great. In adults this can be remedied, if necessary, by rectal feeding. Crockett urges the adoption of this method in all cases except in those where the patient is obviously moribund.

Crockett calls attention to the fact that some cases of undoubted infective meningitis recover spontaneously or with simple lumbar punctures, and cites two such cases, to which McCullagh⁹⁷ adds a third, though many operators still firmly believe that true cases of meningeal infection invariably die. McCullagh says that many cases classed as serous are in reality infective, the failure to secure a growth of bacteria being, according to Dwyer, the use of too-acid media. It is suggested, also, that in certain cases, possibly where the infection is not of a virulent type, the infection may be self-limited, as is at times the case in epidemic cerebrospinal meningitis. In a study of the history of McCullagh's case it is discovered that during the mastoidectomy the dura was torn, the wound enlarged and a rubber drain inserted. This statement, it seems to me, removes this recovery from the class of spontaneous cures and places it directly in that of subtemporal drainage, since practically

⁹⁷ Transactions of American Laryngological, Rhinological and Otological Society, 1916.

the entire technic of Crockett was carried out, the only omission being the lumbar puncture on the table.

The Brain. Since the introduction of the modern ear tests for the localization of intracranial pathological conditions much attention has, perforce, been focussed upon *tumors of the cerebellopontile angle*, and diagnoses are now frequently made with accuracy that were formerly impossible of achievement. Eagleton⁹⁸ gives an excellent discussion and summary of the diagnostic tests employed to determine the presence of these growths. Most of these tumors are of slow growth, and disturbances of hearing and of the vestibular apparatus of the affected side are often the only symptoms of which the patient complains for a long time, and on the recognition of the intracranial origin of the aural symptoms may depend the success of surgical intervention and the reputation of the aurist. Many such cases have and do escape recognition of their true significance, being treated merely as local ear conditions until a papilledema calls attention to the true cause of the deafness. The aural symptoms are but modifications of those manifestations that are so frequent in fractures of the base of the skull extending through the petrous portion of the temporal bone. The end-result of compression of the eighth nerve, whether from fracture or tumor, is the same, namely, loss of function, deafness, and loss of vestibular reactivity. In the one case, however, there is a sudden upset of these functions, allowing an overbalance from the functioning labyrinth on the opposite side to give rise to the characteristic signs of vertigo; while in the other, the growth of a tumor, the slowly increasing pressure allows time for a readjustment of vestibular function. In fracture there occurs, suddenly, tinnitus, deafness, loss of vestibular reactivity associated with vertigo, spontaneous nystagmus away from the affected side and spontaneous pointing reactions toward the side of the lesion. These symptoms are not permanent except the deafness and the loss of reactivity of the semicircular canals. The transient vestibular manifestations result from a sudden, total loss of function of the vestibular apparatus on one side, and the early abolition of these symptoms is due to the readjustment of the vestibular system as a whole to meet the changed condition. It is through this same readjustment of the vestibular apparatus, of the opposite side as well as the affected side, which, in the acute cases, so early abolishes the spontaneous nystagmus, pointing deviations and vertigo, that the slowly growing cerebellopontile angle tumors may first manifest themselves. To determine this diagnosis, use must be made of the functional examinations of the auditory portion as well as the vestibular portion of the eighth nerve. One of the first symptoms complained of is a slight deafness accompanied by an annoying tinnitus. A routine examination with the tuning-forks may, at this time, establish an early diagnosis of an intracranial origin by showing a reduction of the duration of the bone-conduction of the affected side, the reference of the Weber test to the unaffected side, a positive Rinne and often greater alteration of the fork reactions than is accounted for by the amount of decrease of hearing.

⁹⁸ Journal of American Medical Association, February 3, 1917.

When the tumor causes compression of the cerebellar cortex, spontaneous nystagmus is generally present, but not always, because the slow growth allows considerable displacement without symptoms. By the time a nystagmus has developed, total deafness has usually become established and a papilledema may also have appeared. Nystagmus is usually a late manifestation of a tumor developing from the cerebello-pontile angle in contradistinction to tumors growing into it from the cerebellum. Spontaneous nystagmus is also found in cases of tumors of the cerebrum of certain types, but in these there will be no disturbances of the auditory apparatus. In intracerebellar tumors, also, such as gliomata not involving the cortex spontaneous nystagmus may be absent even when the growth attains considerable size, but in these cases deafness is usually not present.

In Eagleton's experience, spontaneous deviations of the pointing reaction are rare during all stages of cerebellopontile angle tumors, and deviations during induced nystagmus are variable and not to be depended upon. The cold caloric test applied to the ear on the side opposite to the lesion is of great value, for in cases of partial deafness there is uniformly a greatly diminished reaction. This sign is often still more pronounced as the lesion progresses to total deafness and papilledema, the symptoms of growing intracranial pressure. At this time no reactivity to the cold caloric test in the ear on the unaffected side is obtainable (frequently, not always), or if slight nystagmus is induced it is transient and not accompanied by vertigo or nausea.

It would appear, therefore, that the aural manifestations of cerebellopontile angle tumor are: (1) Progressive deafness, beginning with a disturbance of the proper relationship between the degree of hearing and the tuning-fork reaction, especially the duration of the bone-conduction to the degree of deafness, and ending in (2) total deafness; associated with (3) loss of vestibular reactivity of the affected side; and during the time that the vestibular apparatus is still functioning (4) a gradual readjustment of the vestibular apparatus of the contralateral, as well as the homolateral, side is going on, which is manifested by (a) a reduction of even a temporary abolition of its reactivity to the cold caloric (at least when applied in the upright position); (b) an absence of the vertigo and vomiting which normally accompany the induced nystagmus from the cold caloric, and (c) absence of spontaneous pointing deviations. As the cerebellar cortex becomes affected, however, may be added: (5) spontaneous nystagmus; (6) spontaneous pointing deviations, and (7) absence, during an induced nystagmus, of the normal pointing deviations of the homolateral side.

BRAIN ABSCESS. Mosher⁹⁹ says that one of the difficult things in the treatment of a brain abscess is to find a drain that does not soon clog and cease to be of use. He has presented a modification of the perforated metal drain in use in the British army, with which he has secured good results in a limited number of cases. The British army surgeons' method of treating brain injuries is described as follows: The dural

⁹⁹ Transactions of American Otological Society, 1916.

wound is enlarged as little as possible for fear of disturbing any walling off which might have taken place between the dura and the pia, and the cavity is probed with great care. No metal drain is inserted if there is not much destruction of brain tissue, the skin flap is turned back into place and a cigarette drain of gauze in rubber tissue run in beneath the base of the flap. This is removed in three or four days if there was no increase in temperature or symptoms, indicating further intracranial involvement. If, however, these did develop the wound was opened up and a metal drain inserted. This drain is a metal tube studded with perforations and is kept filled with glycerin. The gauze over it is also saturated with glycerin in order to soften the necrotic brain tissue and to keep the pus liquid, so that both the cast-off brain tissue and the pus might find their way into the drain. The contents of the drain were removed each day with a small curette.



FIG. 21. The wire gauze brain drain. Each drain is shown with the plunger in place. The plunger makes the insertion of the drain easy. The second drain is the most useful size and shape.

Mosher's modification is to make the drain of copper-wire gauze of a fairly wide mesh. In emergency work it can readily be fashioned from a piece of copper gauze and made any size or shape required by the circumstances attending the particular case under treatment. There should be an obturator to aid in its insertion into the wound or the abscess cavity. It is hard to keep the ordinary brain drain in position, but this wire-gauze drain is almost self-retaining, since granulations at the edge of the wound grow into its meshes and keep it from sliding out. It may

be bent to any shape the operator desires, although the most useful one is ordinarily a cone. It also serves the purpose of an encephaloscope, as the brain tissue can be observed through the wire meshes. And, finally, if hernia of brain tissue threatens, by turning back the edges of the base of the cone an efficient retractor is provided which will make adequate counter-pressure. The glycerin filling aids greatly in securing free drainage.

RADIUM AND THE ROENTGEN RAY. Although radium therapy has had its share of approbrium cast upon it there is no question that, in certain inoperable cases, brilliant results have been obtained by its use, and much has been learned in recent years that has helped to improve the technic of its application. Pancoast¹⁰ has had a large experience in its use for inoperable malignant disease of the ear, nose, and throat, and I personally have seen some of the successes of this method of treatment. When large surfaces must be exposed, as in the treatment of mammary carcinomas, and when intensive deep cross-fire radiation is essential, as in the treatment of abdominal tumors, the method of choice is the use of the roentgen rays. When, however, growths originate in cavities such as the mouth, throat or ear, deep cross-firing by roentgen rays, or possibly by radium, is an essential part of the treatment; but the possibility of adding to the dosage and to the efficiency of the treatment by direct local applications of radium has a distinct advantage. The cases treated by Pancoast include sarcoma of the tonsil, with metastasis to the cervical lymphatics, carcinoma of the tonsil, postpharyngeal lymphosarcoma with metastasis to the cervical lymphatics, sarcoma of the lateral wall of the nose, including the maxillary antrum, and carcinoma of the auditory canal. In these cases a direct application of the radium to the primary growth was indicated, and cross-fire radiation by radium or x -rays was employed for its effect on both the primary lesions and the metastases. He believes that when cross-firing is desirable or is possible only over a comparatively small and superficial area, rather large amounts of radium with heavy filtration can be used to better advantage than roentgen rays. When the area is larger and the lesion deeper, roentgen rays are indicated as the agent of choice.

From the study of numerous cases of diseases similar to those mentioned, which were treated either with radium or the x -rays, or both, Pancoast concludes that:

1. In the treatment of inoperable malignant growths originating in cavities, such as the mouth, throat, and ear, radium therapy is an extremely valuable adjunct for the reason that it can usually be applied directly to the growth, which is more or less inaccessible to direct roentgen-ray exposure. This alone is not sufficient, and the growth should also be attacked from every possible direction by cross-firing, either by radium or by roentgen rays, or both. Any nearby area in which metastasis is likely to occur should also be exposed.

2. When implanted directly into sarcomatous tissue, radium usually causes little or no sloughing if the growth responds promptly.

3. It is advisable to produce as rapid subsidence of the growth as possible in order to minimize the possibility of metastasis during the period of treatment.

4. Our experience has seemed to prove that growths insufficiently treated at the periphery may be stimulated to more rapid proliferation at this portion.

5. Sarcomatous growths, especially in the tonsillar region, are more amenable to treatment than carcinoma.

6. It would be best to continue treatment for some time after the apparent complete disappearance of the growth.

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